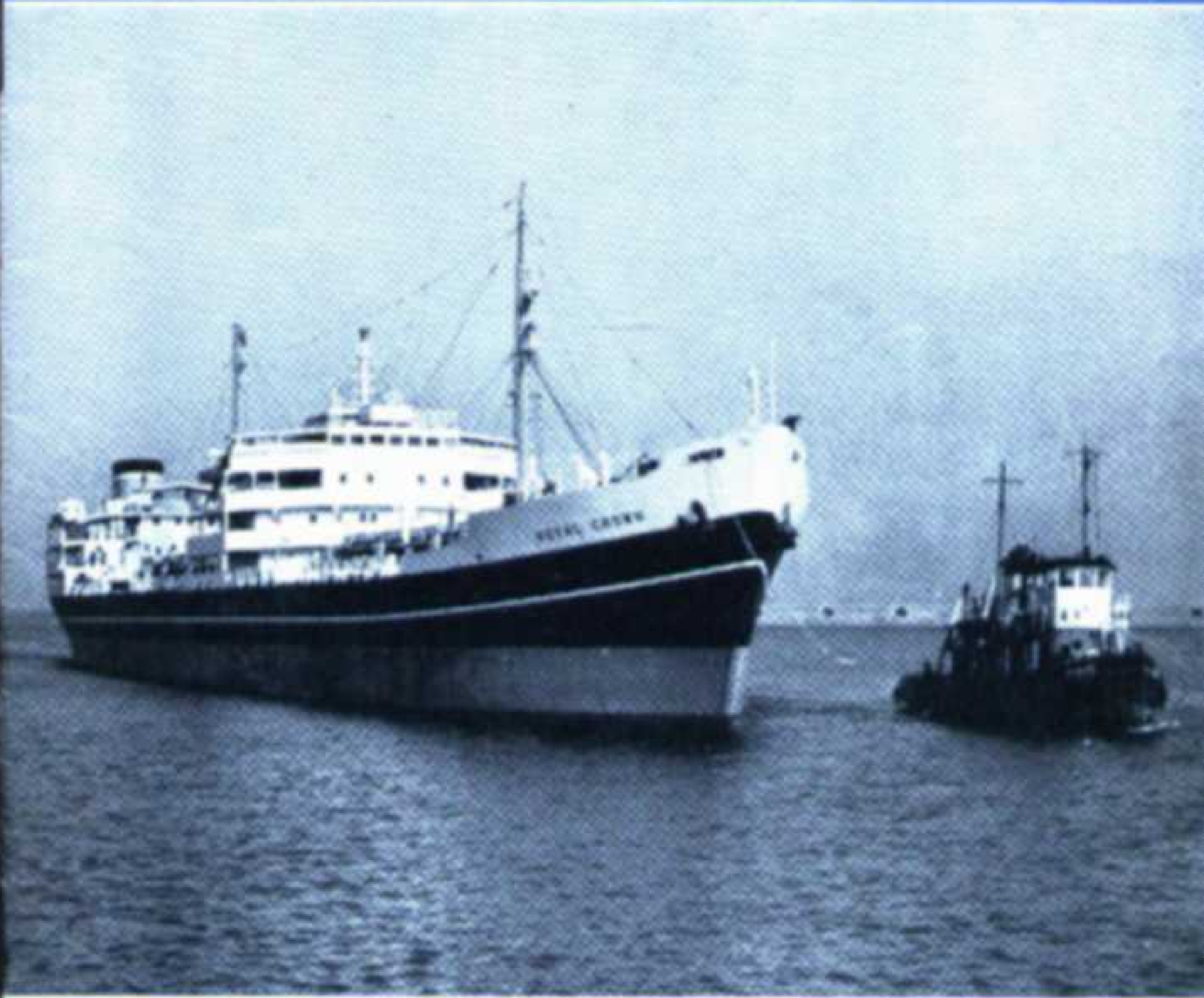
THE MODEL ENGINEER



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DECEMBER 17th 1953
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THE MODEL ENGINEER

EVERY THURSDAY

Volume 109 - No. 2743

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Our Cover Picture

The photograph this week is of the modern tanker *Royal Crown*, in the act of passing her tow rope to the tug which has arrived to tow her into port. In these days, when oil seems to be replacing coal as a fuel, the tanker is becoming more and more important. Great developments are taking place in their construction, and their dimensions; the 30,000 ton mark has already been reached and even larger ships of the type are projected. In the example before us, it will be noticed that instead of a graceful sheer from stem to stern, the deck line forward slopes at a constant angle for, perhaps, a quarter of the way aft, after which it continues dead straight and parallel with the water-line to the stern. Modern ships are frequently built like this, H.M.S. *Vanguard*, being a notable example.

SMOKE RINGS

New Developments

MOST OF our readers take an interest in ship models, especially models of steamships and cabin cruisers, and we believe that still more are interested in seafaring matters generally. These will be interested with the changes which are taking place in our companion magazine, *Model Ships and Power Boats*. Beginning with the next issue—January, 1954—the magazine will be enlarged to 40 pages and will revert to its pre-war title of *Ships and Ship Models*. In addition to the ship modelling features, it will contain sea stories and articles on full-sized ships—their history, anatomy, voyages and design. The new magazine will have a wide appeal and there is certain to be a big demand for the first issue which will be on sale on January 1st, price 2s. Copies can be obtained from your present supplier, please help him and us, by placing your order now.

No "Spotting" at Crewe

IN THE interests of safety, British Railways (London Midland Region) have announced that in future they will be unable to allow youths and children to remain on the railway premises at Crewe for the purpose of engine spotting and watching trains.

For some time children have been arriving at Crewe station at weekends and during the school holidays in such large numbers that there is danger as well as interference with the proper working of the station. A London Midland official has said, that this step has been taken with regret.

We must say that we have been expecting some such step as this, for quite a while. Almost any big railway station today appears to be besieged, by its crowd of youthful enthusiasts, keen on "spotting" the various locomotives that come into sight. Nobody can complain so long as these youngsters confine their enthusiasm to "spotting" the locomotives, but it seems that there are some who are quite incapable of controlling their energies during the quiet periods between the movements of the locomotives and trains. The result is that behaviour is apt to become unruly and out of hand, which cannot be tolerated on a railway station. It is a great pity that such lack of restraint, control and discipline should be so serious as to lead to the ban now imposed by the London Midland Region, as it penalises the well-behaved members of the fraternity; but, apparently, no remedy can be suggested.

To Traction Engine Enthusiasts

FILM SHOWS have now become a popular form of entertainment at certain meetings of model engineering clubs and kindred societies, and we have pleasure in passing on an offer that has reached us from Mr. J. Shaw, 67, Hibbert Crescent, Sutton-in-Ashfield, Nottingham, who writes:

"In spring this year, I was fortunate in attending the Traction Engine Rally at Andover. I offer club secretaries the loan of a 5-minute film I made of this event in 9.5 mm. size. It is not much, but I think it would be an item of interest to those, like me, with specialised tastes for engine oil, smoke and good hot steam."

If any reader who may be looking for an interesting item for a film show, would like to borrow this one, he should get in touch direct with Mr. Shaw.

Index for Volume 109

THE ISSUE for December 31st, will be the last one of the present volume and will contain the index. Readers will recall that we were able to revive this method last June, due to the improved conditions with regard to paper supplies. There is usually a big demand for the issue containing the index, and there is no reason to suppose that our December 31st issue will be any exception in this respect. So readers should make sure of their copies by placing their orders early.

THE ALLCHIN "M.E." TRACTION ENGINE to 1½ in. Scale

By W. J. Hughes

I RECENTLY had the pleasure of meeting J. S. Christopher, of Ainsdale, Lancs, who is building the Allchin, and, incidentally, whose method of making the tee-rings for the hind-wheels I shall describe before long.

A few months ago, Mr. Christopher paid a visit to *Royal Chester* in Kent, and made a series of "close-up" photographs of detail parts, chiefly for his own guidance, of course. Now, however, not only has he sent me a set of the prints, but he has very kindly given permission for me to reproduce any of them in these articles, for the benefit of other constructors.

This friendly and helpful attitude is typical of our fraternity, I know, but other beneficiaries will want me to express our gratitude to Mr. Christopher for his kindness.

Continued from page 559, *November* 5, 1953.

Proposed, seconded, and passed unanimously!

The first two photographs, then, are given herewith, showing respectively the left-hand and right-hand hind-wheel hubs. It will be noticed that the left-hand hub-cap is very much the worse for wear—probably due to an argument with a stone gate-post or other similar obstacle. Still, it *does* give us a chance to see the end of the hind-axle, and the collar which holds the wheel in place. This photograph also shows well the driving-pins, and the method of retaining these in position.

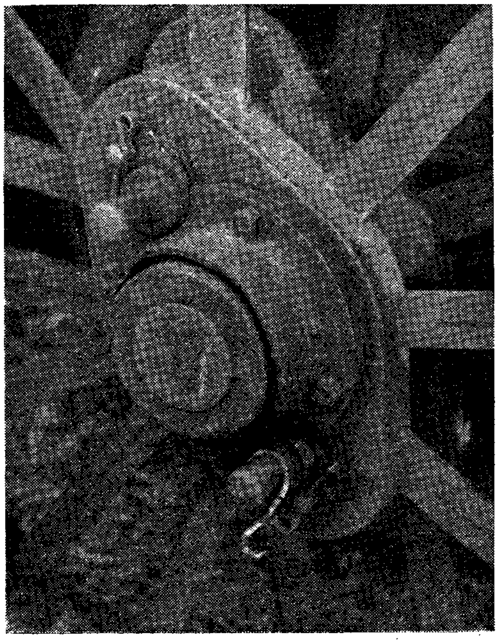
On the other picture the hub-cap is whole, and, of course, this hasn't to be cut away to clear the driving-pins. By the way, we are hoping—A. J. Reeves and I—that hub-caps for the model will soon be available with the lettering cast in, as seen on this photograph, but more of this anon.

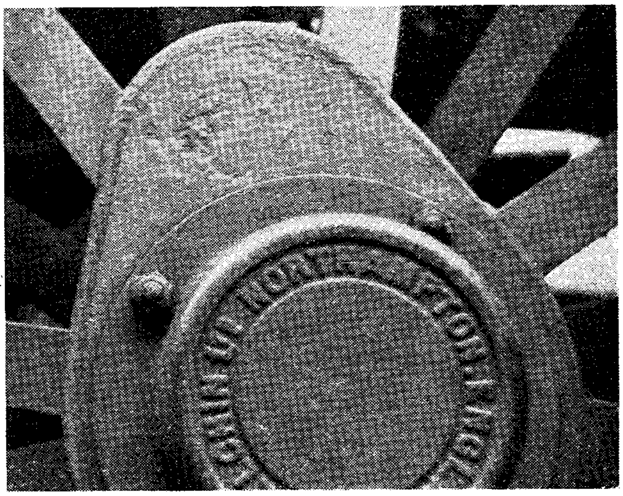
Outside Ends of the Hubs

As with the hub-centres, probably the best method of holding the ends of the hubs is to grip them in the four-jaw chuck, and as before, the chucking-spigots can be sawn off. Take the outside end of the left-hand hub first, and set it in the chuck to run truly, with the larger spigot outside. Face up the outer surface, and turn the spigot to be a good fit in the corresponding counter-bore in the hub-centre.

Using the tailstock drill-chuck, centre and drill out the hole, up to ½ in. diameter; then bore it out to be a good fit on the left-hand end of the hind axle.

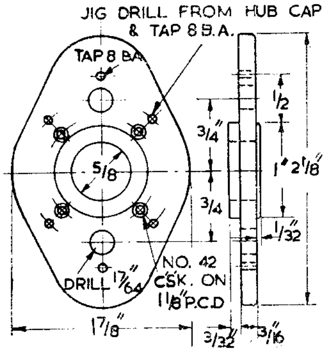
Remove the work from the chuck, and mount the *inside* end of the left-hand hub in the jaws. This is machined in exactly the same way, and so are the two ends for the right-hand hub.



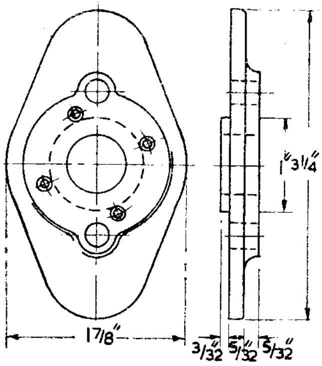


Photograph No. 51. *Right-hand hub of the prototype*

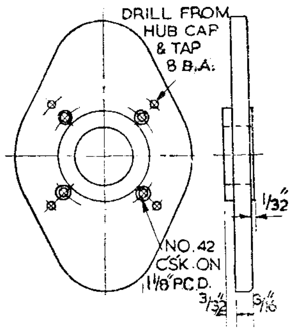
Photograph No. 50 (*left*). *Left-hand hub, broken hub-cap, and driving-pins*



Outside end for left-hand hub. Do not drill holes for pins at this stage



Inside **end** *for left-hand hub.*



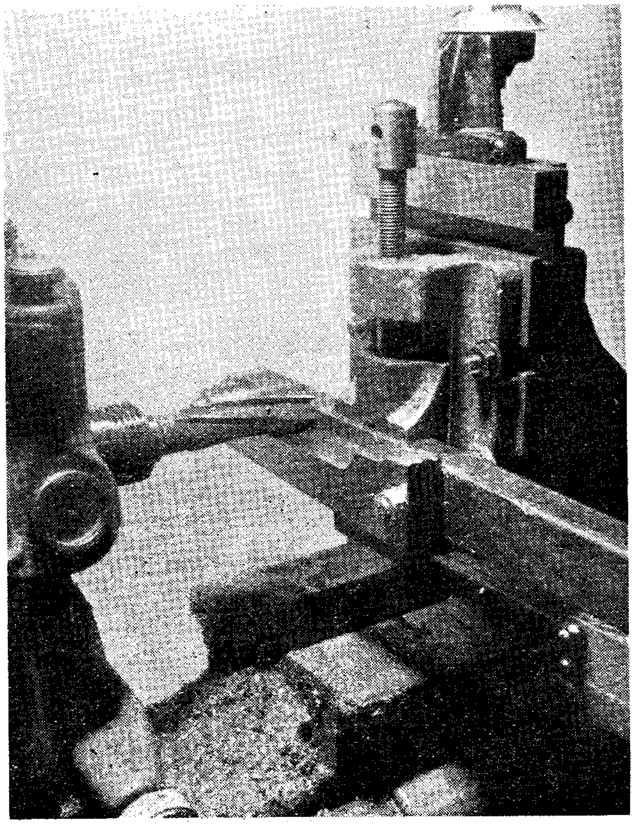
Outside end for right-hand hub: note, no *holes for driving-pins*

Finishing the Hub-Centres

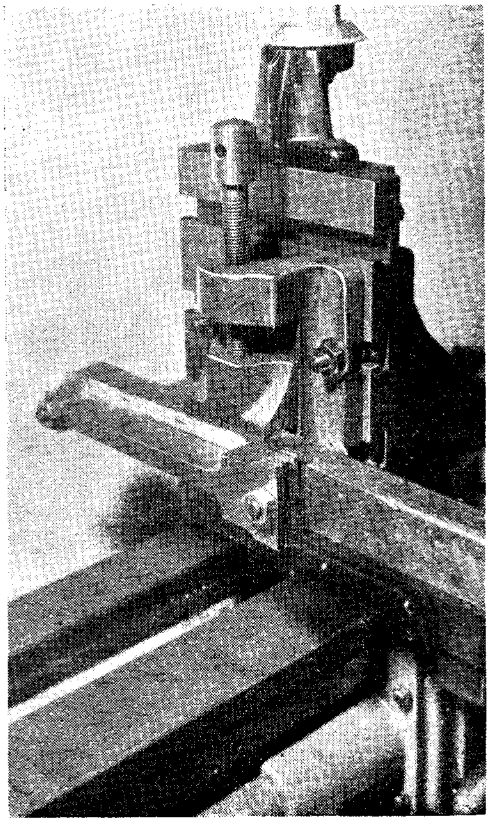
The outer faces of the hub-ends must now be machined, and the best way of doing this is on a stub-mandrel, since the spigots on the outer faces should be concentric with the bores.

However, when making the stub-mandrel, make it long enough to mount the hub-centres, because we still have to counterbore one end of each of these. Press one of the centres on to the mandrel, and counterbore the end to fit the spigot on the corresponding hub-end. Note that it is *important* that each spigot should fit its counterbore perfectly; so fit them carefully and individually. Otherwise, if there is any sloppiness, not only may you get the bores out of line in assembly, but the completed hubs will have lost strength because of the poor fit.

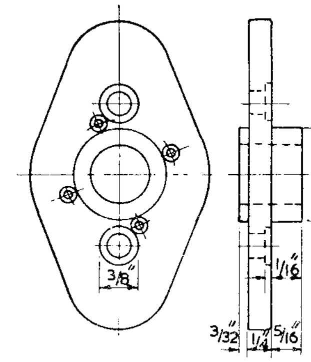
When the first of the hub-centres has been counterbored, remove it from the mandrel and replace it with the other centre, which now



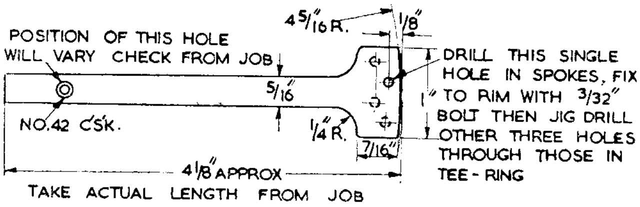
Photograph No. 52. Batch of spoke blanks being milled to shape



Photograph No. 53. Batch of spokes after milling



Inside end for right-hand hub: do not drill pin-holes



Spokes for hind wheels: lengths will vary slightly

requires the same treatment.

Finishing the Hub Ends

After this, you can turn down the length of the mandrel to $\frac{5}{8}$ in. or so, which will make it a convenient length for mounting the "inside end" of the right-hand hub, small spigot inward.

The outer face is now turned to leave the flange $\frac{1}{4}$ in. thick, and the boss is turned to a length of $\frac{5}{16}$ in. and a diameter to fit the counterbore in the driving boss. Remove from the mandrel, and turn the stub of the latter down to about $\frac{3}{8}$ in. long.

Press on to it the inside end for the left-hand hub, small spigot inwards, and face up the outermost surface.

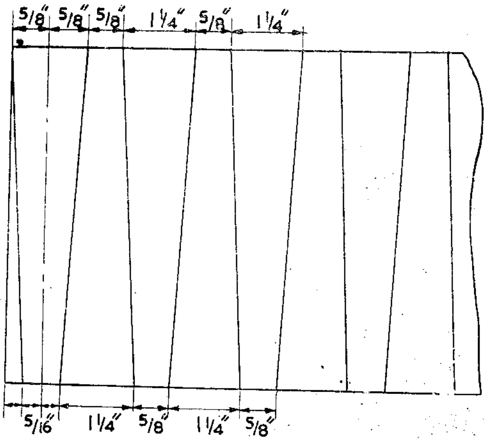
Finally, in turn, face up the outer surfaces of the hub outside ends, to leave the flanges $\frac{3}{16}$ in. thick and the spigots 1 in. diameter by 1/32 in. long. These small spigots are to act as registers for the hub-caps, and the latter will have to be bored out to suit, when we come to them.

Just one point—it will be a help later if, while you have the outside ends of the hubs mounted on the mandrel, you scribe a line across the major axis of each. Use the surface-gauge set to centre height for this, of course.

If you like, you can now drill the countersunk holes (No. 42) for the screws which will hold the components together, and from these the 8-B.A. holes in the hub-centres can be jig-drilled and then tapped. After inserting the screws to clamp the pieces, the outside edges of the flanges should be filed up to level them off flush. The outer and inner edges of the flanges should be slightly, but only slightly rounded, as seen in the photographs. Do not drill any of the other holes yet.

Hind Wheel Spokes

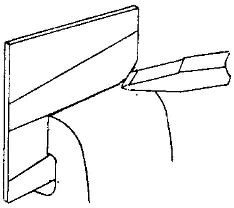
At a recent exhibition, a fellow said to me that he thought the trouble with a traction-engine was "all that repetition." Pressed for details, he said, "Well, all those wheel-spokes, f'rinstance." But, as I pointed out to him, with such items as these, we can use a bit of "mass production," and so save quite a lot of work *and* repetition. Altogether, for both wheels, we need thirty-two spokes for the hind wheels, and if we had to bash these out of plate or strip individually, it certainly would become a bit tedious. However, the method to be described is quite simple, and it can be done on the lathe or adapted to a milling-machine, if you possess one.



How to set out blanks for spokes

If you can obtain 1-in. by 14-gauge steel strip for the spokes, that too will save some work, but if not, you'll have to use 14-gauge sheet as I did. Cut a strip off $5\frac{1}{4}$ in. wide, and set it out as shown in the sketch, which just allows that little extra for a machining allowance, and for perhaps a slight error in cutting (though not *too* much).

Next thing is to cut off the strips, and with a reasonably decent set of bench shears that presents no difficulty. However, if you only possess hand shears, these won't

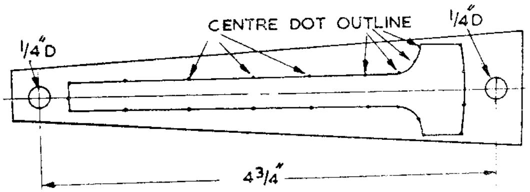


How to cut the blanks without bench shears

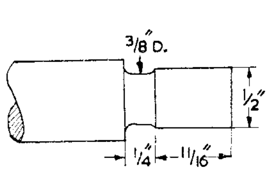
tackle 14-gauge steel, and a cold chisel is indicated. It's surprising how quickly the job can be done, if you grip the work in the vice jaws with the line just showing, and hold the chisel with the cutting-edge at about 20 deg. to the surface of the metal, as sketched. The chisel then acts as the movable blade of the shears, with the vice as the fixed one. The shearing will have left the blanks rather twisted, and they will need flattening with a hammer on a metal block. A heavy hammer with medium blows is best for this, by the way; heavy blows are likely to dent the metal. And also by the way, you needn't bother to file up the edges of the blanks, nor need they be *dead* flat; they can be toned up after shaping.

Another Jig for Milling

My blanks were milled to shape in the lathe, with a commercial end-mill. They were mounted on a jig which was itself gripped in the machine-vice bolted to the vertical-slide (see photographs). The jig

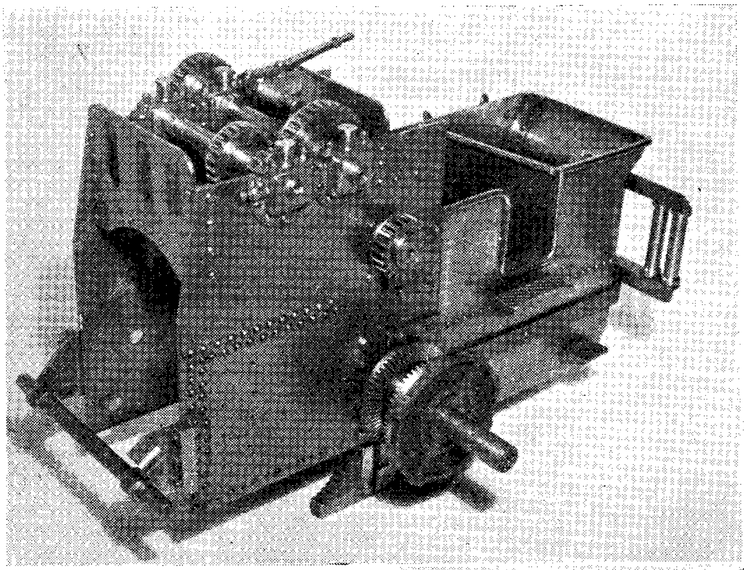


Shape of master spoke set out on blank



Blank for spoke milling-cutter, if no end-mill is available

was made from a piece of wrought-iron bar from some old railings; the sort of thing you keep for years in the workshop because you know that one day it will "come in for something"—which this certainly has done! The bar was 1 in. by $\frac{7}{8}$ in. section, not too accurate, but a skim over each face with a 1 in. diameter end-mill soon rectified that. Next, one of the blanks was set out carefully, to act as a "master,"



Photograph No. 54. Coming on nicely, thank you! Mr. C. E. Molyneux's Allchin

with an equal amount of waste at each end. The two $\frac{1}{4}$-in. holes having been drilled, it was clamped in place over the centre-line of the jig-bar, and used as a jig in drilling two $\frac{1}{4}$-in. holes in the latter.

Now the master blank was clamped on top of a pack of four of the other blanks—a single tool-maker's clamp in the middle sufficed—and the holes were drilled through the four. This operation was repeated until all the blanks were drilled, and so the holes in every one were equally spaced with each other, and with those in the jig-bar.

Incidentally, you will note that my bar was longer than it really need have been; this was because I didn't want to saw off the "waste"; I might need the full length of it at some future time! And, of course, the actual breadth and thickness of your bar aren't important, so long as it is stout enough—you must use your discretion about that.

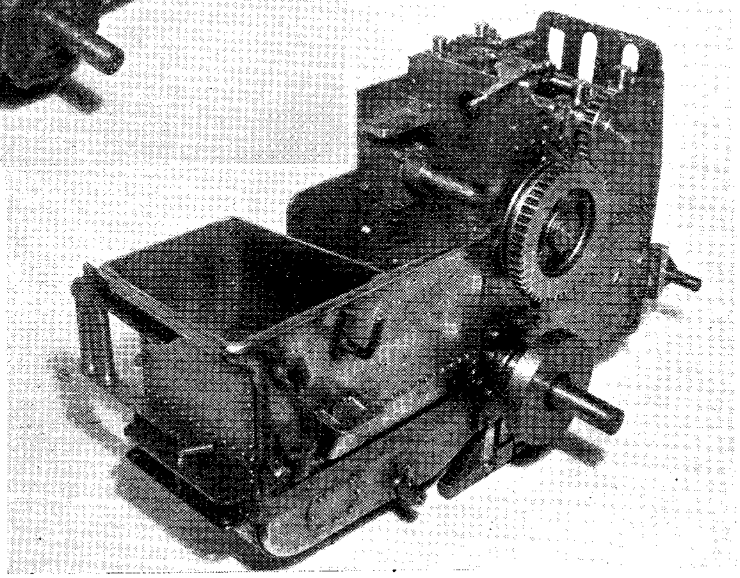
Milling the Spokes

In use, the bar is gripped in the machine-vice, which is bolted to the table of the vertical-slide; the outer surface of the bar must be at right-angles to the lathe axis, naturally, and its centre-line should be parallel with the lathe bed. Centre-dot the spoke-outline on the master blank, slip two $\frac{1}{4}$-in. bolts through the holes in the jig-bar, from the back, and thread on to them seven of the other blanks, with the master on top. Put a washer and nut on each bolt, and tighten up. Use the surface-gauge from the lathe-bed to see that the centre-line of the master traverses parallel with the lathe-bed, and then we're all set for the milling. I used a stouter end-mill—1 in. diameter—for removing the bulk of the waste, but it is necessary to finish off with one of $\frac{1}{2}$ in. diameter in order to get that $\frac{1}{4}$ in. radius where the spoke is palmed out.

By the way, this is one case where the "slot-drill" type of home-

(*Continued on page* 714)

Photograph No. 55 (below). Certainly looks like the prototype, doesn't she?



The Humble VICE

By "Base Circle"

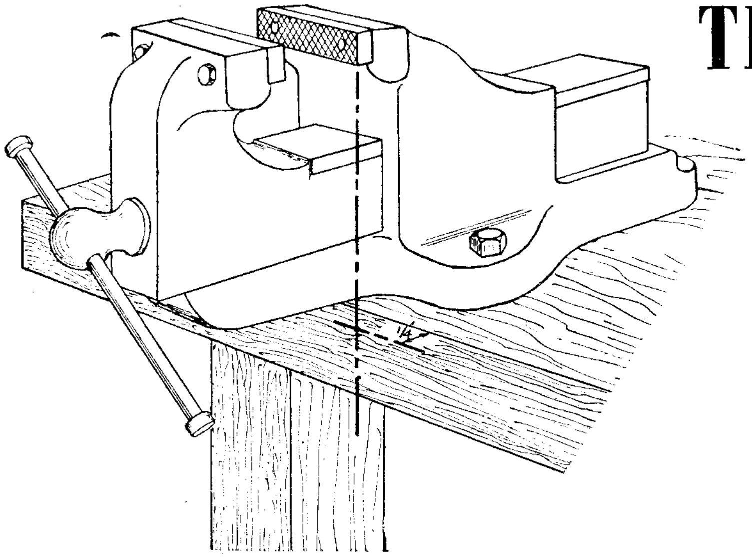


Fig. 1. Showing position of vice on bench

THERE are many tools and appliances in our workshops with which we could, at a pinch, dispense, without too much inconvenience, but the one tool we just can't do without is surely the vice. Yet how little care or attention does this indispensable tool get? Practically none, I fear! Just have a look at the vices in your friends' workshops—or even at your own for that matter—and what will you find? Too often a battered old implement buried in the filings of the present job, the last job, aye and possibly the one before that. Try it and what do you find? Loose jaws and a screw that is too tight—and a handle that obstinately refuses to drop down out of the way or else drops so suddenly and so violently that it nips the fingers every time it is used. Often the vice is insecurely fastened to the bench or fastened in the wrong place. Now why should this be? Why should the vice be the Cinderella of the workshop? Why should such care be lavished on the lathe—perhaps I should say LATHE—while the humble vice languishes neglected and uncared for. Books and articles galore are written on the lordly lathe—but who ever writes about a vice?

Attention Please

Quite seriously, though, the vice does merit more attention. Ten minutes spent on it from time to time will be well repaid. Let us see that it is properly bolted down on the most rigid part of a sturdy bench, under a good light. Then, having cleaned it and oiled it, we will find the vice ready for all its ordinary work. But don't forget that a good vice can, with the help of a few simple gadgets, do all sorts of jobs—jobs that are not normally looked on as vice jobs at all. And now let us get down to brass tacks.

Choosing a Vice

Even for amateur work, the vice should be reasonably heavy. When it is too small, it is a constant source of annoyance. A 4 in. vice—that is having jaws 4 in. wide—is a good useful size. A 3 in. vice may do, but it is on the light side,

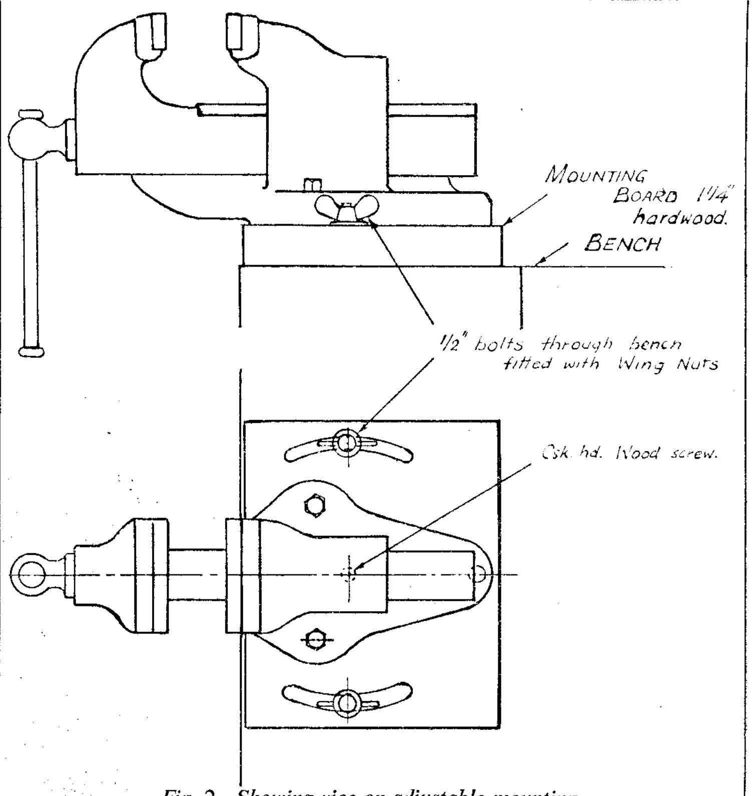


Fig. 2. Showing vice on adjustable mounting

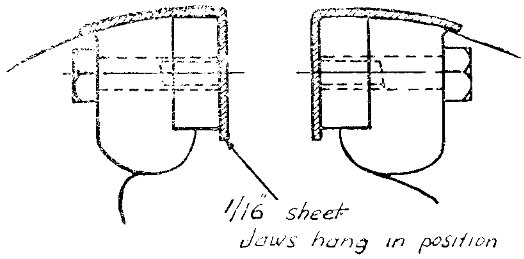


Fig. 3a. False jaws—loose type

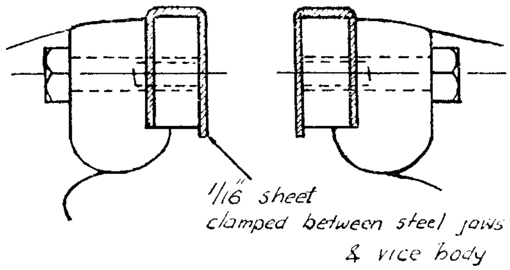


Fig. 3b. False jaws—rigid type

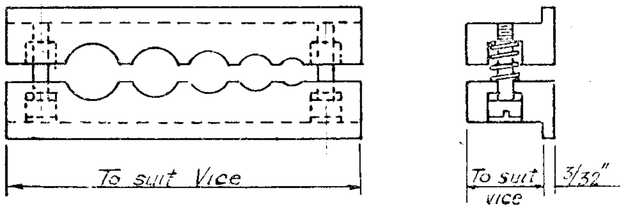


Fig. 3c. Showing jaws for gripping round material vertically

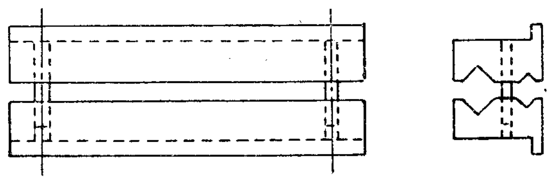


Fig. 3d. Showing jaws for gripping round material horizontally

and will have to be treated gently. A bigger vice than 4 in. would be even better, but it will take up a lot of room, and it will be rather expensive. The point to be remembered is that the big vice will do all that a smaller one will do, and in addition, it will tackle jobs that are far beyond the scope of the smaller one.

A cast-iron vice is as a rule all that we impecunious workers can aspire to, but, of course, if expense can be disregarded, by all means let us have a steel one. Steel vices are practically unbreakable, and will give a lifetime's service.

Nowadays nearly all vices are of the parallel motion type. The old leg-type, with the moving jaw hinged on a pivot near the floor, which used to be quite common, is hardly ever seen, except in some old-fashioned country smithy. In any case, the parallel type is to be preferred for our work. Most makers of vices offer the parallel type with or without a quick-acting device on the screw. This usually consists of a half nut which can be pulled out of engagement with the screw by means of a trigger conveniently situated near the handle. Well, my advice is to stick to the good old-fashioned screw-all-the-way type. The other type is undoubtedly faster in use, but surely we, who are working for our own pleasure and amusement, are not in such a desperate hurry that the slight saving of time is of any account. Against this one advantage we have the very serious disadvantages—first, that it is more expensive (a very serious consideration in my part of the country) and second that the quick-acting device is by far the most likely part of a vice to give trouble. No, the expensive quick-acting vice is well worth having in the factory, where seconds count, and where repairs or replacements present no difficulty, but for our purpose we are better advised to stick to the old, well tried, slow but sure, screw-all-the-way type.

A minor point which is worth consideration is to note how the hardened jaws are screwed to the fixed and sliding parts of the vice. In some cases, countersunk screws are used, with the screws going through the jaws and into the casting. Well, we all know that countersunk screws are difficult to tighten, and in this case the difficulty is aggravated by the fact that unless the sliding jaw is completely withdrawn, the screws are not readily accessible. For this reason, the other design which uses hexagon-headed screws which go through the casting and are tapped into the steel replaceable jaws is much to be preferred, more especially if the accessories and gadgets to be described later are to be used.

Mounting the Vice

Having obtained our vice, let us take care to get the best out of it, by bolting it securely to a good

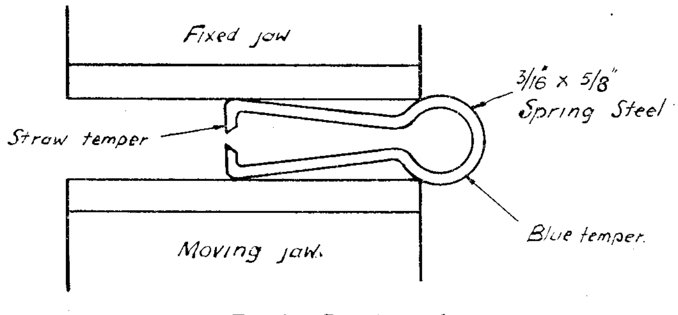


Fig. 4. Cropping tool

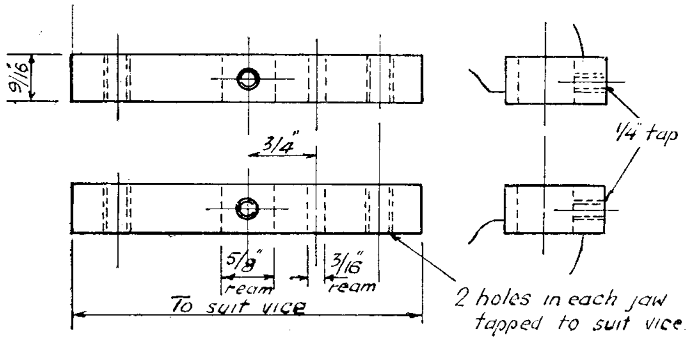


Fig. 5. Jaws for press work

substantial bench. The front plank of the bench should be, if possible, two to three inches thick, and the vice should be placed directly over one of the bench legs. It is worth while, too, to see that the leg over which we place the vice comes over a solid part of the workshop floor—above a joist, for example, in the case of a wooden floor. As a rule, the left-hand end of the bench is the most convenient location for the vice but, of course, a lot depends on the layout of the workshop. Through bolts rather than coach screws should be used. As regards the height of the vice, the old-fashioned rule still holds good—that the top of the vice should be the same height as the worker's elbow above the floor. This does not apply to the case of the individual who works seated. I don't know of any rule which does apply in that case, and I could never understand how anybody could work at a vice while sitting, but I daresay one can get used to anything—an old Scots saying asserts that " you get used to anything but hanging." To proceed. Care must be taken in mounting the vice, to see that long articles held vertically will be clear of the bench. To ensure this, the fixed jaw should be about a quarter-of-an-inch in front of the bench, as shown in Fig. 1. It will be seen that the vice shown there is of the plain screw-all-the-way type, having the loose jaws held in place by hexagon-headed screws.

It will often be found to be a great convenience, in dealing with an awkward job, to be able to swivel the vice out of parallel to the bench. Special bases for vices can be bought, which give this facility, and indeed vices can be obtained which can be tilted to practically any position, but all these gadgets are expensive. A certain amount of movement can easily be obtained by mounting the vice on a piece of board, which in turn is mounted on the bench by means of bolts through curved slots in the wood. The board should be of hardwood, and should be about $1\frac{1}{2}$ in. thick. The bolts securing the vice to the board will require to be sunk below the surface. The board pivots on a centrally placed wood screw, and is secured in the required position by tightening up the two nuts. These nuts can, for convenience, quite well be of the winged variety. (See Fig. 2).

Maintenance

Once we have our vice properly mounted, all that is required is to keep it in good condition. Even a vice needs cleaning and oiling occasionally ! Sometimes the jaws will be found to have worked loose, usually after some heavy hammering has been going on in the long-suffering instrument. Where the jaw screws go in from the outside, this can be helped to some extent by fitting spring washers under the screw heads. Where countersunk-head screws are used, I fear there is nothing for it but to keep tightening them up.

As supplied, the vice will be fitted with a pair of serrated jaws in hardened steel. These are excellent for rough work, and will provide a tremendous grip. They will, however, make a horrible mess of finished work. To obviate this, something must be interposed between the finished surface and the rough vice jaw. To begin with, we will probably make do with a piece of plywood or something of that kind, but one soon tires of trying to hold two pieces of wood plus the job all in place with one hand, while the other is used to tighten up the vice. The usual solution is to use two jaw covers made of brass, copper, or aluminium, as shown in Fig. 3a. It will be seen that the metal is bent so that the corners hang over the steel jaws. This is certainly a great improvement over loose packing. Better still, I think, is the method shown in Fig. 3b, where the soft cover is caught between the steel jaw and the vice itself, and then hammered neatly over the front of the jaw. The great drawback to this idea is fairly obvious, that is that the covers are not so easily removed when necessary. Nevertheless, I would still recommend this method, for with the jaws covered with rigidly fixed protectors in this way, it will be found that the vice grips so securely that it is hardly ever necessary to remove the covers. Indeed, in my own case, false jaws of this kind are usually left constantly on the vice until they are worn out, when they are replaced by new ones. The same effect can be obtained by removing the steel jaws from the vice, and fitting in their place jaws exactly similar but made in brass. These will be found to be very

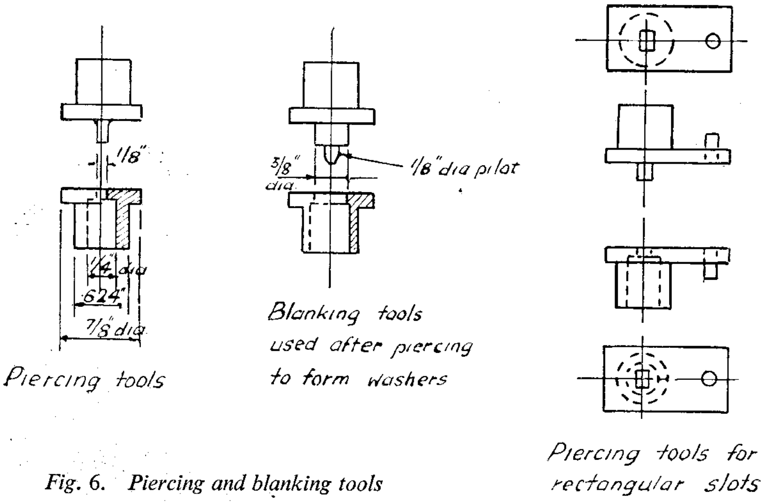


Fig. 6. Piercing and blanking tools

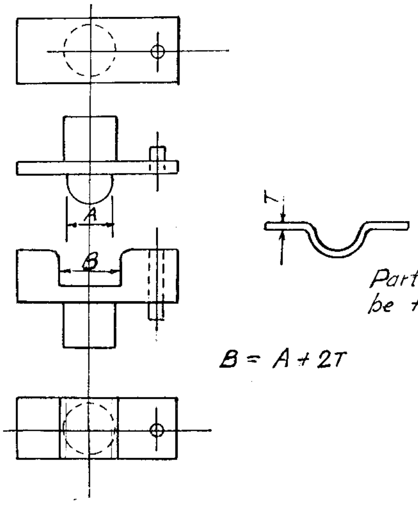


Fig. 7. Forming tools for clip

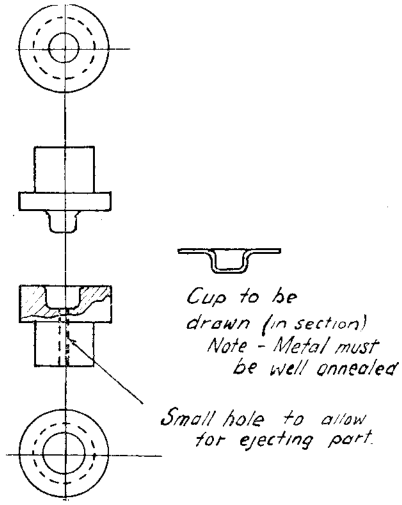


Fig. 8. Drawing die

effective, and as they are fairly thick, they can be dressed up when worn and will thus last for quite a long time. The jaws so far described are for ordinary straightforward work, but all sorts of jaws can be made to grip parts for which the usual flat jaw is not suitable. At Fig. 3c and 3d we see examples of such jaws. Fig. 3c shows a jaw suitable for holding round pieces—screws for example—and the holes may be plain or may be tapped to suit the work. When dealing with screwed work, such jaws are almost a necessity. At Fig. 3d we have jaws intended for gripping round work in a horizontal position. If an adjustable stop is fitted to the vice, we will have a ready means of cutting off rods to uniform length.

Other Uses for the Vice

So far, we have only considered the vice as a means of holding work while it is being operated on, but now let us consider some of its many other uses.

First of all, it can be used for pressing pins or bushes into place. This is a much better way of dealing with this kind of work than to use a hammer.

Then, with the addition of the gadget shown at Fig. 4, it may be used for cropping bars. It will prove a much easier way to cut material than any hand-operated tool.

Fig. 5 shows the vice adapted to be used for press work. All that is necessary is to fit to the vice a pair of special jaws arranged to carry the punch and the die in correct relation to each other. The sketch shows a pair of such jaws. They are a bit thicker than usual to allow for the grub-screws which hold the tools in place. They are located in the $\frac{5}{8}$ in. diameter reamed holes. (The small reamed hole is only required when the tools being used are not circular.) With suitable tools, this method may be used quite successfully either for piercing holes of any desired shape in sheet metal, or for producing blanks of any desired shape. We must avoid attempting such work in metal of too heavy a gauge, but as the pressure is being applied by hand, it is fairly easy to judge when one is overdoing it. In brass, copper, and aluminium, it is surprising what can be done. Washers can readily be produced by piercing a row of holes in a strip of suitable material and then blanking, using a piloted punch which locates in the holes already pierced. Fig. 6 shows various dies including tools for washer making.

Apart from piercing and blanking work, the vice can be used for bending and forming. Fig. 7 shows a set of tools for producing a clip of the type illustrated. It should be noted that there is no need in a case like this to waste time forming the die to the correct profile. It is only necessary to make sure that the punch is of the required form, and that the gap in the die is of the

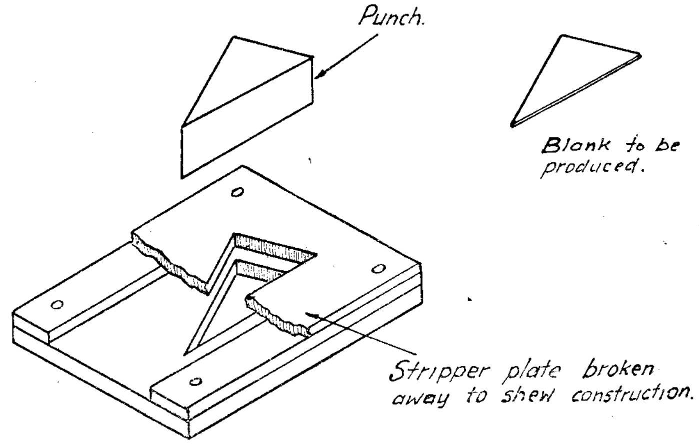


Fig. 9. Simple blanking die suitable for operation in vice

proper width, and all will be well. I mention this, as professional toolmakers have been known to fall into this error ! Drawing work can also be carried out in the vice, on a very limited scale, of course. Suppose we want a few little cups as shown in Fig. 8. These can quite easily be made with a pair of tools as illustrated. The material to be used must always be thoroughly annealed, and it is better to restrict this operation to brass, copper or aluminium — preferably the latter two.

Harking back to the blanking and piercing tools already described, it will probably have been noted that these are only suitable for very small parts, and it will be obvious that, when blanking, the die must be taken out before the blanks can be removed. This is not a serious matter, but at the same time, for larger work, dies of a type used commercially for small quantity work are probably better. An example of this kind of die is shown in Fig. 9. The tool is intended to produce the triangular part shown beside the die. The shape, by the way, was chosen not because it is a likely shape to be required, but because it is easy to draw, and, anyway, it shows the principle ! The punch is made to the shape required, and is a fit in the stripper plate and in the die. The stripper thus guides the punch and keeps it in correct relation to the die. To produce a part, the material to be used is pushed into the die, under the stripper plate, the punch is inserted in the stripper, and then the whole assembly is put in the vice and pressure applied. When the tool is removed from the vice the shaped piece will fall out. If several parts are required, a strip of material of suitable width will be cut and fed through the die, repeating the punching process as often as desired.

These are only a few of the many ways in which the vice can be used for light press work. Many others will, I have no doubt, readily suggest themselves to the reader.

Possibly I had better forestall criticism by saying that I am quite well aware that in many cases it will take longer to make punches and dies for a few parts than to make the parts by hand without special tools. On the other hand it will not take *very* many parts to justify the press method, and it is much more pleasant to spend, say, two hours making one set of tools, than to spend the same length of time making half-a-dozen parts all exactly the same. In any case, many of us, I think, derive as much pleasure from the making of tools as from the using of them. Let us leave to the professionals the uninteresting job of worrying out whether special tools are economically justified or not. We are free agents—we can make what we like when we like, and if we care to spend our time die-making, well and good ! ! Just one other point before we leave the subject of dies, that is that for the limited use which these tools are likely to get, there is no need to bother about hardened steel. Mild-steel will stand up surprisingly well, even as a blanking tool on tinplate.

There are still many other uses to which the vice can be put. For example, where there is no lathe, a hand-drill clamped in the vice will provide a means of rotating small jobs while they are operated on with a file. Not exactly a substitute for a lathe, but a great deal better than nothing ! I know of one workshop where the hand-drill could be mounted on the moving jaw of the vice while the fixed jaw carried a plate which did duty as a table, thus forming a crude screw feed drill. Again, only a makeshift, but it saved a lot of effort when dealing with the larger holes.

In conclusion, let me remind the less experienced workers to be kind to their vices by working close to the jaws. Don't strain the screw by trying to hold a job rigidly while you hammer it six inches away from the grip.

The Allchin "M.E." Traction Engine

(*Continued from page* 709)

made end-mill *won't* do, because we need the cutting-edges on the face of the tool. However, it is not a difficult matter to make a ½-in. diameter milling-cutter to do the job, in the same way as we made the form-cutter for milling the splines on the second-shaft. In fact, it's an easier job than making the form-cutter ! Turn the end of a piece of $\frac{9}{16}$-in. or ⅝-in. diameter silver-steel as shown: " plane " on it eight or ten teeth, as described for the form-cutter, centre-pop opposite No. 1 jaw before removing from the lathe, relieve the tips of the teeth and harden and temper. That's all there is to it.

My procedure in milling was first of all to level off the top edge of the palm, and then to mill down nearly to the other line, taking about 30-thou. off at a time, and using the inch-diameter cutter. This was then changed for the ½-in. end-mill, and the ¼-in. radius and top edge of the spoke were finished with this. Actually I did not mill exactly to the line, but left two or three thou. on, so that in building the wheel, each spoke can be individually fitted into its own slot in the hub-centre, so as to ensure a tight fit. The undersides of the blanks may now be milled at the same setting, of course, running them over the top of the cutter. The next photograph shows the finished batch of spokes ready for removing from the jig.

Having done this, place another eight blanks in position, *with the master spoke on top*, and tighten the nuts finger tight. Run your scriber round the master, to transfer its outline to the one beneath, and remove it. Replace nuts and washers, and tighten down properly. Having centre-popped the outline on the top blank, you should now proceed to mill this batch to shape. Remember, however, that you now mill right down to the line itself, because this already allows the few thou. extra for fitting.

The other two batches of blanks are milled in the same way, of course, but use the same master each time when marking out, in order to prevent cumulative errors. And there we are, with the thirty-two blanks ready for the finishing, which isn't a long job and will be described next time.

A Huddersfield Allchin

Although a large number of small Allchins are taking shape in different places—not only in this country, but in many parts of the world—and although many readers have sent photographs of their bits and pieces, I had never seen one " in the flesh " until recently. This was at the Huddersfield club's exhibition, and I had the pleasure of a chat with the builder, C. E. Molyneux, of that society. As the picture shows, he is making a very nice job of the engine, and she should be a credit to him when finished. By the way, Mr. Molyneux has cut his own gears, and he said he was agreeably surprised at the comparatively short time which was needed for this.

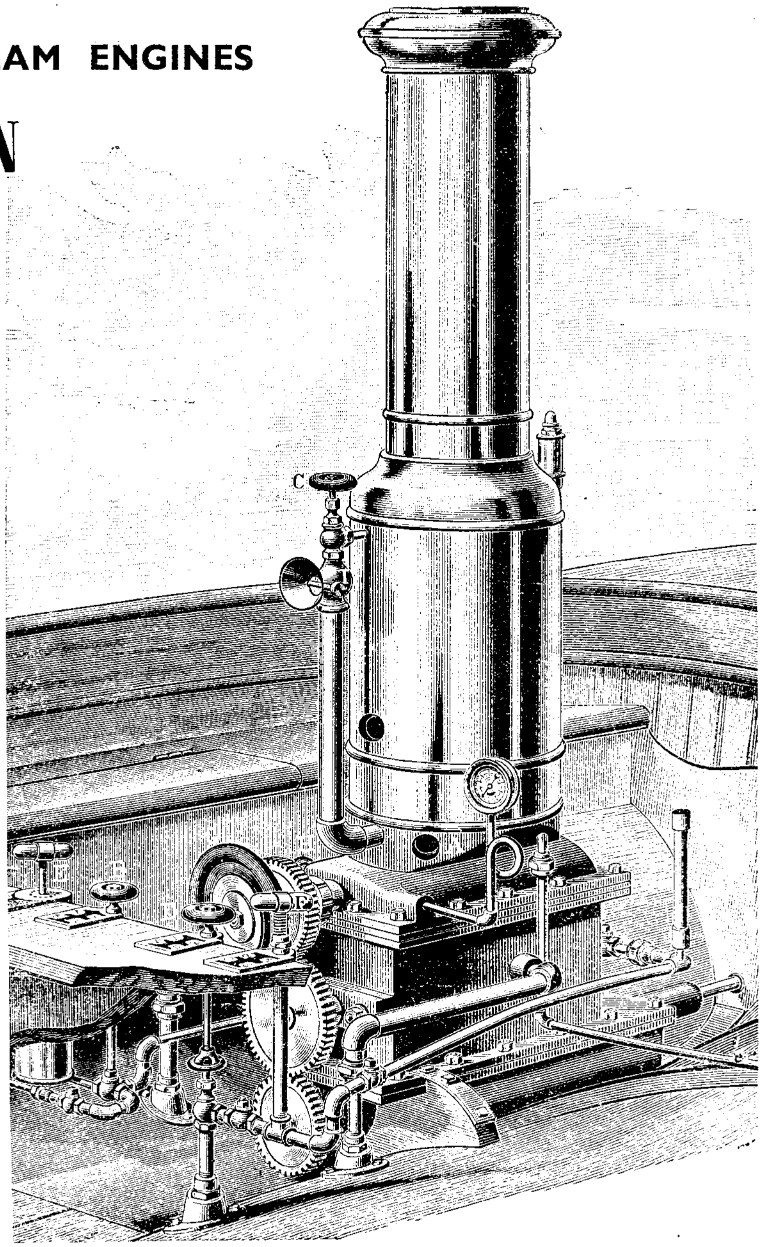
(*To be continued*)

MORE UTILITY STEAM ENGINES

HYDROCARBON VAPOUR ENGINES

By

Edgar T. Westbury



A Naphtha Vapour launch engine by the Gas Engine & Power Co., New York

HAVING given full working details of two widely different types of engines in the present series, which I trust will temporarily give occupation, or at least food for thought, for many constructors, I now propose to digress for a while from constructional topics, to give some general particulars of a little-known type of engine which, to be strictly correct, is not a steam engine at all. The excuse for including it in this series, however, is that except for the fact that it operates on pressure pre-generated from liquids other than water, its working principles are identical with those of the steam engine, and it offers possibilities which experimenters may find interesting.

It will be clear to everyone that while nearly all "pressure-cycle" engines (for want of a more exact generic term) use water as the raw material of the working fluid, because it is the cheapest and most readily obtainable liquid on earth, practically any liquid could be evaporated by the application of heat, and re-expanded in a suitable form of engine, either of the displacement or turbine type, to produce power. Many experiments have been made in the past, with liquids ranging from ether to mercury, or even in some cases liquefied gases, for driving engines. I do not propose to go in detail into the relative characteristics of different liquids or their potential advantages for this purpose; but putting it briefly, the lighter and more volatile liquids, which boil at low temperatures, can be used to exploit a lower temperature range than water, while heavier liquids can effectively utilise higher temperatures, and in the case of mercury, its high heat conductivity helps to reduce heat transmission losses. There are, however, various difficulties in using these liquids, and none of them has yet been found to give practical results which justify their extensive employment as a substitute for good plain (the plainer the better !) water.

It is, however, interesting to note that some sixty or seventy years ago there was a limited but quite definite vogue, particularly in the U.S.A., in engines designed to run on hydrocarbon vapours; they were usually of fairly small size, and their principal application was in the propulsion of river launches and similar small craft. Many advantages were claimed for such engines, but quite possibly there was another, and no less important reason for their existence; they enabled certain regulations for the running and maintenance, which had been laid

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Continued from page 669, December 3, 1953.

down in most states of the U.S.A. for steam plants, to be side-tracked or circumvented. Their reign was apparently short, but considerable ingenuity was devoted to their design, and for that reason alone, they are worth considering, as many of their features are capable of being adapted and applied to more orthodox steam engines.

Few readers, I venture to suggest, have ever encountered these engines, if indeed they have ever heard of them; I have never actually seen one, though I had been intrigued by vague references to them in old engineering journals (no text-book I have read has so much as mentioned them !), and have long sought more definite particulars of their design. At long last, this was forthcoming, when I received a visit from Mr. W. J. Chapman, of Minneapolis, whose primary quest was for details of model steam engines, in which I was able to be of some assistance. In course of conversation, he informed me that he had seen an example of a marine vapour engine in a museum, and being very interested, had followed this up, and succeeded in obtaining some very old catalogues describing vapour engines of two different types. At my urgent request, he has loaned me these catalogues, which form the source of the illustrations and particulars given herewith.

Naphtha Engines

The catalogue issued by the Gas Engine and Power Co., of Morris Dock Station, New York City, in 1890, includes a description and illustration of their naphtha engines of 2 to 16 h.p. for boats of from 18 to 50 ft. in length. Although the engraving of the engine, which we have succeeded in reproducing, gives no insight into its internal design, it appears to incorporate a totally enclosed reciprocating engine having two or more cylinders, surmounted by a device reminiscent of the orthodox cafeteria urn, termed a " retort "—possibly to exempt it from the regulations appertaining to boilers !—containing a generating coil and pressure burner; in fact, what we model engineers would call a flash boiler. Both the fuel and working fluid of this engine was mineral naphtha, otherwise known as " stove gasoline," which was very cheap at this period.

To quote extracts from the catalogue description of the engine, it was stated that it " differs from all other engines used for the same purpose, whether run by gas, oil or steam. Steam engines . . . occupy so much room, and by their *weight* so diminish the speed of the boat, that many attempts have been made to substitute some other motor which would accomplish the greatest amount of power within the smallest possible space. . . . All engines heretofore constructed to run by the use of oil have failed to meet the required demand. . . . *Our motor* differs as much from these as it does from steam engines, and is far superior to the steam engines now in use, for small boats, and launches.

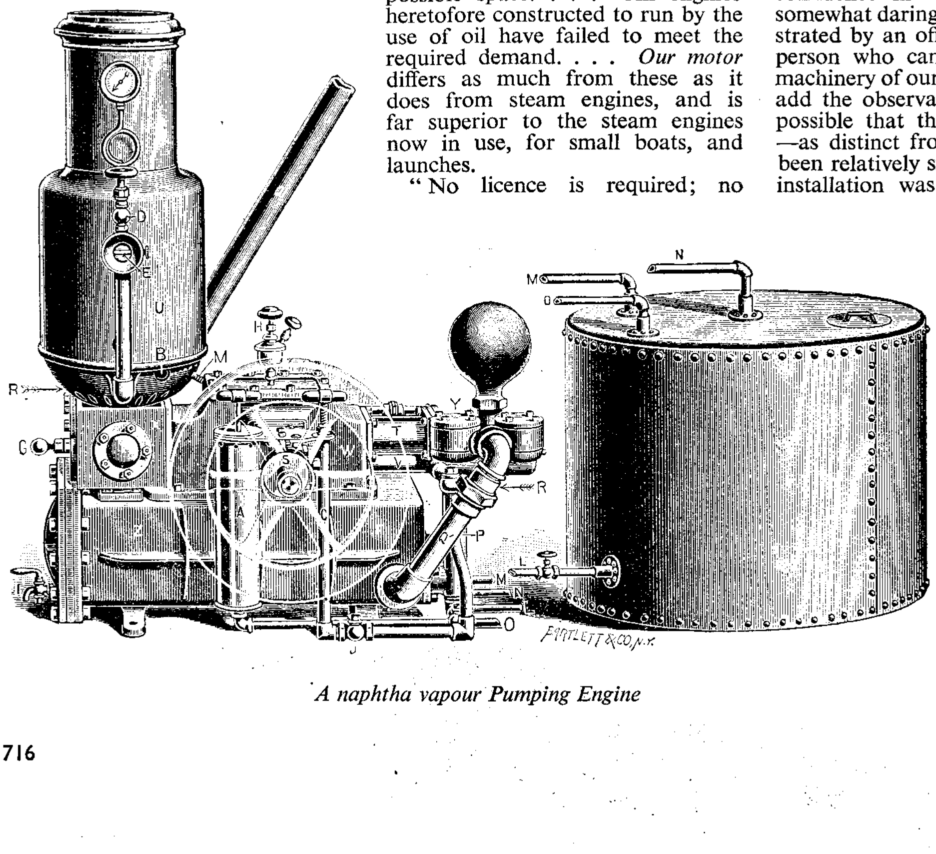
" No licence is required; no engineer needed, and any person of ordinary intelligence . . . can run our engine with ease and safety. . . . Many have been deterred from using (steam) boats, because of the trouble of using *coal*, the necessity of obtaining a government licence, engineer, etc. . . .

" The small space taken by our engine . . . *gives more room*, enabling the boat to seat *twice* as many persons as a boat of the *same* size fitted up with any other engine."

Particulars are then given of the weight of the various sized engines, ranging from 200 lb. for the 2 h.p. size, to 800 lb. for the 16 h.p. size; which in all cases was claimed to be less than one-fifth of the weight of other engines and boilers of the same power. It was stated that the engine could be started up in from two to five minutes; that it could be stopped from full speed " within the length of the boat," and the reverse motion was " instantaneous and effective." Pumping engines operating on the same principle were included in the catalogue.

The cleanliness of the plant was also stressed, and a careful distinction made between this, " the only naphtha vapour engine " and other " improved naphtha engines," in which the naphtha was used only as fuel for the boilers of steam engines. Another point stressed was that the system was absolutely *safe*, confidence in the validity of this somewhat daring claim being demonstrated by an offer of $500 " to the person who can explode boiler or machinery of our launch." I would add the observation that it is quite possible that the risk of explosion —as distinct from fire—might have been relatively small, so long as the installation was completely in the open, and not enclosed in an engine room.

Instructions on how to start the engine were given, as follows: " Turn Air Valve *B* from left to right; give Air Pump *E* sufficient number of strokes (2 to 5) to force gas from tank, through outlet pipe to burner, and ignite by match introduced through hole in base *A*, and so heat retort by means of the flame, which is



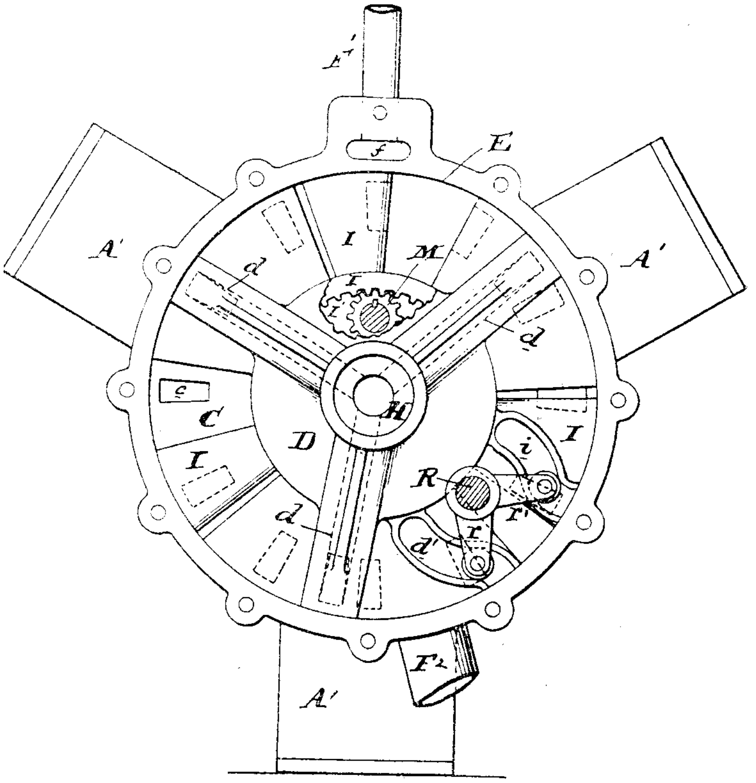
A naphtha vapour Pumping Engine

kept up by using the Air Pump. Use Air Pump one or two minutes in warm weather; but in cold weather much longer, as gas generates very slowly in the tank.

"Open wide Naphtha Valve *D*, and give 10 to 20 quick strokes with Naphtha Pump *F*, which pumps Naphtha from tank in bow to Retort on top of Engine, and if Retort has been sufficiently heated, the pressure will at once be indicated on gauge. Then open Injector Valve *C*, which supplies fuel to burner, and keeping the Damper *I* partially closed, especially if there be much wind blowing; after which, by the Handwheel *G*, which is the starting and reverse wheel combined, turn the Engine over several times, both forward and back . . . during which operation the fire will go down, unless prevented by four or five strokes of the Naphtha Pump *F*, as often as necessary to keep the fire going and the pressure at about 20 pounds, until the engine starts itself.

"Should fire go out, it is important to shut off Injector Valve and light by using Air Pump, as before, opening Injector immediately thereafter. If Engine starts or turns over hard, block open Safety Valve, and keep using Naphtha Pump; this allows pressure to go through the Engine, and blows out condensed Naphtha that is on top of piston. To go ahead, turn wheel *G* to the left; to back, turn to the right.

"*Now the Engine takes care of itself.*"



End view of the Alco Vapour Engine, with end cover removed to show method of port control

Alcohol Vapour Engines

The rival claims of alcohol as a working fluid, in comparison with naphtha, were stoutly upheld in the catalogue issued by the Marine Vapor Engine Co., of Jersey City, N.J. describing their "Alco Vapor Engine"; this is undated, but is obviously of much later date than the previous one, as it includes testimonials dated 1896. Again, quoting from the catalogue *verbatim* it states:—

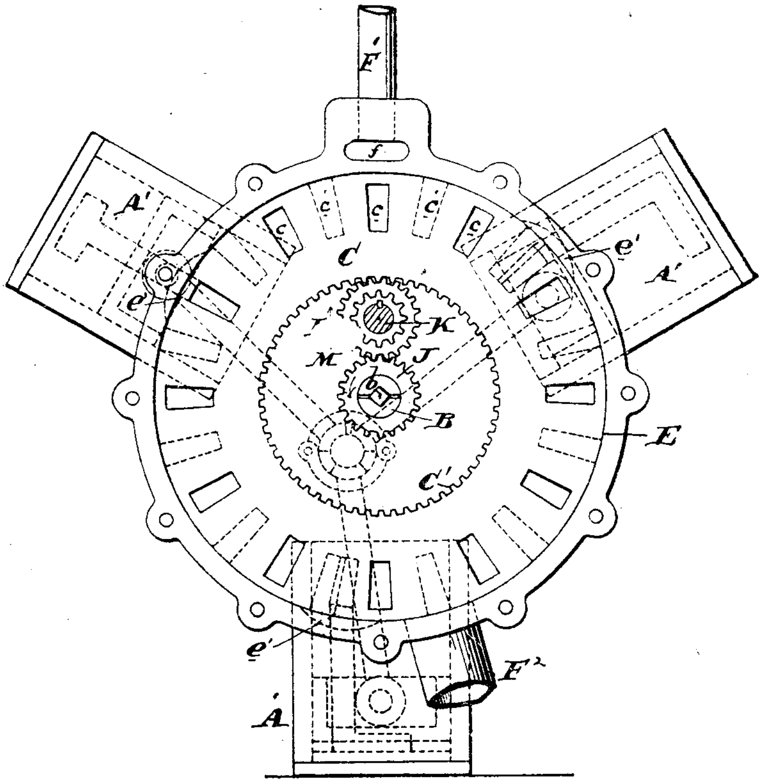
"As we use alcohol expansively for power it may be asked, wherein does it differ, and in what respects is it better than naphtha? In answer to the first query, we will state that alcohol has the peculiar property of expanding a greater number of times and at a lower temperature than naphtha. . . . A recognised authority gives the boiling point of naphtha at 320° Fahr., water at 212° Fahr., and alcohol at 173° Fahr. So it will appear quite obvious that should we begin to create pressure at 173°, by the time we increase the temperature to the boiling point of water we have fifteen pounds (per sq. in.) and before we reach the boiling point of naphtha we have a pressure of one hundred pounds.

"In fact owing to the low boiling point of alcohol it is not necessary in starting the Alco engine to laboriously work the liquid out of the cylinders by turning the engine by hand as in the case of naphtha, for immediately we have 25 lbs. pressure—our engine starts without aid, and owing to the small amount of heat required one can fearlessly place their hand upon the casing of the engine when running at 100 lb. pressure.

"But our intelligent critic may say, admitting all the advantages you claim, is not alcohol dangerous? Our answer is *No*, for unlike naphtha, it combines with water in all proportions, and should any be allowed to escape, the fact that there is always a small quantity of water in the bilge (of a boat) eliminates any likelihood of fire. This could be demonstrated by the simple experiment of taking a spoonful of alcohol, igniting it, and then pouring it into a glass of water; the flame will be immediately extinguished, while it is a well-known fact that naphtha burns more intensely upon the surface of the water than elsewhere.

"As we carry but one-tenth as much alcohol as is usually carried of naphtha by naphtha or gasoline engines, and use the same over and over with but little attention during the entire season, the convenience and safety of our system will be readily seen and appreciated."

A number of further claims, similar in general terms to those made for the previous engine, are followed by a technical description of the plant, which is apparently arranged in a similar manner to the naphtha engine—the mechanical portion being surmounted by a vertical retort, with a tall chimney—and from the illustrations, a considerable amount of ingenuity is shown in the design. The retort or generator is composed of steel tubing throughout, and tested to 1,000 lb. hydraulic pressure. No details are given of the burner, except that it uses kerosene or



View showing rotary valve and differential driving gears

"headlight oil" and burns with a blue flame. "In most states of the Union it is unlawful to sell a lamp oil which will not extinguish a burning match when placed in it." (*sic.*).

The very unusual engine of this plant had three single-acting cylinders *A*1 arranged radially, with the pistons *A*2 acting on a single crank-pin *B*. Vapour distribution was effected by means of a rotary valve *C* of the disc type, driven from the crankshaft by means of an internal differential gear at one-twelfth engine speed; it had twelve sets of ports, the admission ports *cc* passing straight through, and the exhaust ports leading from one side out to the periphery of the disc, and thence to an annular passage *e*1 in the casing, connected to the exhaust pipe *F*2.

Here arises a minor mystery, for it would appear that with twelve equally spaced sets of ports in the valve, the cylinder ports would all open to steam or exhaust simultaneously; but this anomaly was overcome by offsetting two of the cylinder ports to either side of the angular centre line (at 120 deg.) of the cylinders themselves.

The most ingenious feature of the design was the method of engine control, which instead of using a normal regulator or throttle in conjunction with some form of reversing gear, employed a means of direct control of the admission timing and period, at the valve face. This was done by the use of what was termed a "riding cut-off valve" which was made in two parts, *D* and *I*, each with three equally spaced segmental faces, placed in contact with the back or outer side of the disc valve. Both components had specially shaped cam tracks formed in them, at *dl* and *i* respectively, engaging rollers *r* and *r*1 on a right-angled bell crank mounted on the control shaft *R*, which passed through to the back of the casing and carried a hand lever *P*, working over a notched quadrant.

When this lever was moved, the rollers on the bell crank operated one or other of the segmental valves so as to vary both the width and the angular position of the opening from the vapour receiver *G* to the back face of the disc valve. While either roller was moving in the curved slot of its respective member, the latter did not move, but as the roller moved nearer to the periphery, it caused the member to move through a limited angle, only one member being affected at a time. It will be seen that the member *I* also incorporated the stationary internally-toothed wheel of the differential gear, and its movement, therefore, effected a positive phase shift of the disc valve itself. In this way, the movement of the single lever *P* on the shaft *R* could be used to control both the degree of expansion of the vapour, and also reversing of the engine.

Although the construction of the engine was undoubtedly rather complicated, the working parts were all readily accessible by detaching the control lever *P* and removing the casing *F*. It would appear that the practical success of such an engine would be largely dependent upon precision fitting of the working parts, especially the rotary valve and its contacting surfaces, and also their wearing properties; one is inclined to wonder whether the standards of commercial production of the period were really adequate to do justice to such a design. No mention is made of lubrication, though this must have been a highly important consideration; neither are such items as fuel and water feed pumps, or devices for automatic control of these functions, described, though every model flash steam enthusiast knows how essential these provisions would be, especially in the hands of unskilled operators.

In all vapour engines, conservation of the working fluid, by condensing the exhaust vapour and pumping it back to the tank, would be necessary on the grounds of economy; but beyond a brief and vague mention of "copper feed and condensing pipes," this feature also is studiously omitted from both catalogues. I am of the opinion that it would not be at all easy to maintain joints, glands, piston rings, etc., in such perfect condition as to avoid leakage and wastage of vapour at these points, not to mention fire risk.

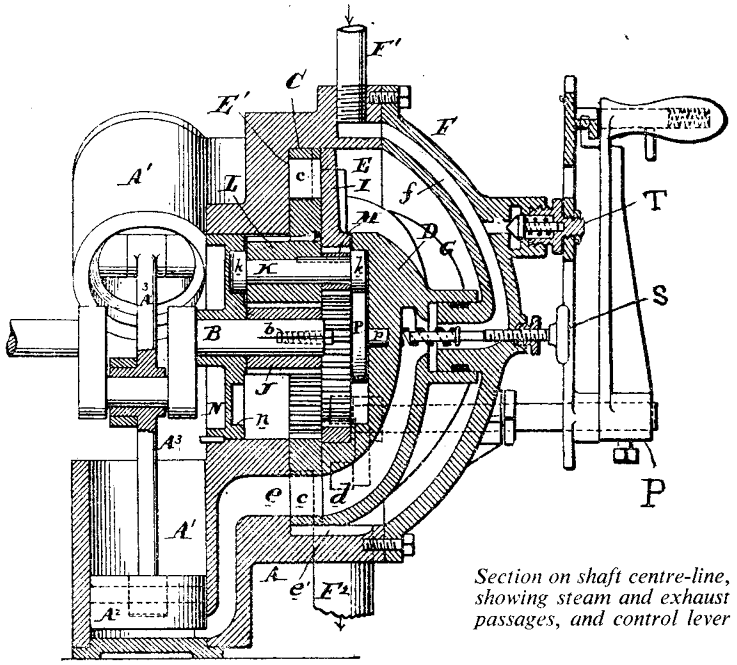
Incidentally, the makers of the Alco Vapor engine also had complete faith in the immunity of their engine from risk of explosion, and backed it to the tune of $1,000. (I wonder, now, whether these claims were ever challenged—and what, if anything, happened ?)

Before closing this brief interlude, I may perhaps be allowed to mention

an experiment I made several years ago in the use of alcohol vapour to drive an engine. My idea was to boil methylated spirit in a pot boiler, and after using it to drive an engine, to pass the exhaust into a bunsen burner to heat the boiler. All beautifully simple, and it worked—up to a point. The principal snag was that the quantity of vapour exhausted was far too large to be used effectively, or properly controlled; apart from that, it proved to be expensive in fuel consumption, and wisps of vapour leaking here and there would always manage to get themselves " lit up " in the literal sense. These problems might have been solved in time, but the experiment being, as it usually is, a very rough " hook-up," it came to grief in a spectacular holocaust when certain soft-soldered joints became overheated.

So for the benefit of other intrepid experimenters—if you play around with inflammable vapour at high pressure, and succeed in burning the house down or blowing yourself sky-high—don't say I didn't warn you !

(*To be continued*)



Section on shaft centre-line, showing steam and exhaust passages, and control lever

For the BOOKSHELF

British Standard Locomotives. (London: The Locomotive Publishing Co. Ltd.). 20 pages, size 6½ in. by 8 in. Illustrated. Price 1s. 6d.

This brochure includes a descriptive text, names, numbers, photographs, diagrams and principal dimensions of the ten standard types of steam locomotives so far placed in service on British Railways. Printed on art-paper, the text is concise and explanatory, as well as descriptive, while the illustrations are clearly reproduced. It is a useful little publication which we cordially recommend to any of our readers interested in locomotives.

The Midland Railway, by C. Hamilton Ellis. (London: Ian Allan Ltd.). 192 pages, 5½ in. by 8½ in. Two coloured plates; one diagram; one map; numerous half-tone illustrations. Price 25s. net.

In an age in which there is being produced an enormous quantity of railway literature, some good and some not so good, this book appears and straightway can be placed in the first of the two categories just mentioned. Railway histories are often somewhat pedantic in style and frequently tainted by an author's unreasoning bias in favour of his subject; but this book tells the story of one of the really important and most influential of English railways, and in a free-and-easy style enlightened by flashes of humour that make it a pleasure to read.

The Midland was a wealthy railway which could afford to do things in the grand manner, and although its methods may sometimes have been open to question, it was undoubtedly popular with the travelling public, if only because of the unusual degree of comfort and spaciousness provided for the passengers. Added to this were the generally neat, clean and uniform appearance of its passenger trains, the elegance of its locomotives—especially in its latter years—and, above all, the extreme punctuality of its services, at a time when strict time-keeping on other lines was the exception rather than the rule. The scenic beauties of its terrain and the neatness and scrupulous cleanliness of its stations maintained and enhanced a reputation that remained unsullied throughout practically the whole of its independent existence.

All this is vividly portrayed by the author of this book in language that is commendably free from extravagance and rhetoric. The locomotive history, in particular, is remarkably concise, complete and accurate, supported by numerous illustrations, some of which are of great interest. The book also publishes, we believe for the first time, a diagram of R. M. Deeley's proposed 4-cylinder compound tank engine. About 1909, a few vague rumours of such a proposal emanated from Derby; but the engine never appeared and was eventually forgotten until now, and the author is fortunate in having brought the official diagram to light. Obviously, many sources have been thoroughly combed for photographs to include in this book, and the large selection provided is a most satisfactory gesture in these austere days; although the locomotives predominate, there is scarcely a characteristically Midland feature that has been forgotten. As a comprehensive general survey of the history of a great railway, written in a style that can only be enjoyed, this book has few equals.

LUBRICATOR RATCHET TROUBLES

By "L.B.S.C."

ANOTHER example of the curious way in which queries sometimes interlock, has presented itself in recent correspondence. My account of how I repaired the old chime clock, amused quite a lot of the followers of these notes; several have written to inquire after the present health of "Old Faithful," and whether there have been any more instances of misbehaviour on its part! I have also received some complaints about ratchet gear wheels on mechanical lubricators. Readers say, that they have fitted up the ratchet gear as described in my instructions, and it has worked fine when first installed; but trouble has occurred with the engine on the road, the oil feed ceasing through the pawl missing the ratchet-wheel teeth. Lengthening the swing of the lever, cures the missing, but causes uneven feeding, the ratchet jumping two teeth for part of the revolution, and causing the engine to throw oil from the chimney. The complaint is, that on some of the ratchet wheels supplied, the teeth are visibly inaccurate, being more closely spaced at one part of the periphery; this naturally accounts for the uneven feed. Querists ask for a brief note on how to cut their own ratchet wheels, reminding me that I have mentioned more than once, that this job is easy, and can be done on any lathe. O.K., anything to oblige, and we will proceed to shoot both birds with the contents of one barrel.

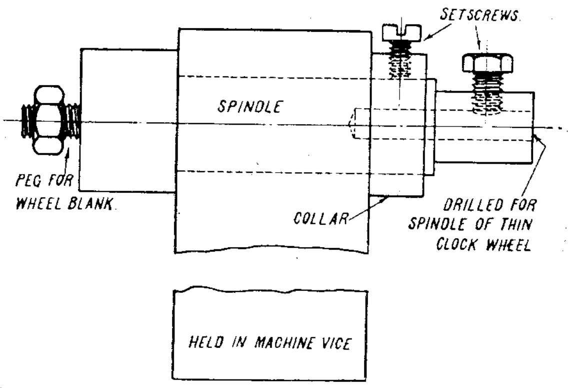
"The Still Small Voice" Calls!

After the repair recently described, the chime clock kept on keeping on, running well to time, chiming the quarters and striking the hours with unfailing regularity, in the manner usually observed by all respectable members of the A.S.C.C. However, there was just one little thing that a still small voice kept repeating at the back of my noddle. Something wasn't quite right, and it worried me. Curly has ever been the same, from childhood to old age; anything that wasn't right, worried me until I put it right. Now that darned wheel on which I performed a dental operation, was far too thin for my liking. The spring was a mighty strong one; well I knew it, too, when replacing it in the spring-box after joining the broken ends, as it wanted some coiling in with unavoidably oily fingers. One side of the box was a little larger in diameter than the box itself, and had teeth cut all around it, to form the first wheel of the driving train. This was over $\frac{1}{8}$ in. wide, with hefty teeth to match. It geared into a corresponding pinion on the first shaft; and directly attached to the side of this pinion, on the same shaft, was the wheel which I had repaired, transmitting the drive to the rest of the train. When I "miked" the thickness, before inserting the make-up piece which replaced the broken teeth, I found it was only 0.040 in. thick. Now a gear wheel only a shade over 1/32 in. in thickness, transmitting the pull of a powerful spring to a fairly heavy pendulum, through a train of gears and a quite sturdy escapement, seemed to your humble servant like coupling a powerful goods engine to a train of wagons plus a 50-ton brake van, by means of a link off the bathplug chain. True, it had run for twenty years or so, before the teeth started to give up the ghost, which, incidentally, was due to the sudden violent recoil of the spring-box when the spring first conked out; but that didn't alter the fact stated above. Anyway, it worried me so, in case any more of the weakened teeth failed, that I decided, as soon as an opportunity knocked, to fit a stronger wheel.

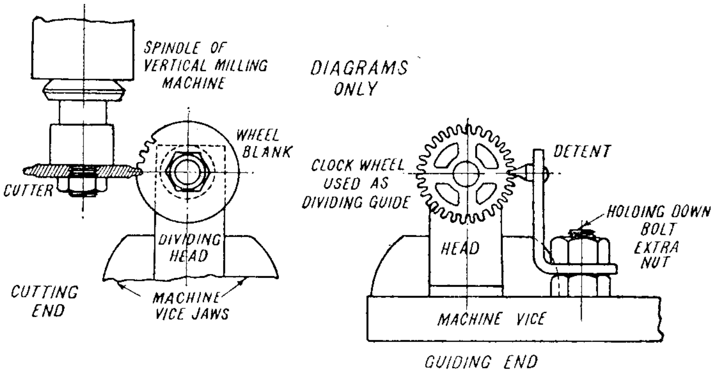
Improvising a Dividing-head

I don't possess a dividing-head, nor in fact any wheel-cutting apparatus at all, and I wanted to do the job quickly, time nowadays being my biggest enemy; so I decided to use my vertical milling-machine, rigging up a ragtime dividing-head (courtesy title!) on it. The main part of this as shown in the illustration, was simply a bit of brass bar, which I happened to have handy, and was of requisite size. I won't bother about giving specific dimensions in these notes; if anybody would like to follow suit, they also can use anything that they have handy, and can be adapted to their machine. The piece of bar was gripped in the machine-vice on the table of my drilling-machine, and a 31/64-in. hole put through the thickness near one end, followed by a $\frac{1}{2}$-in. parallel reamer, which trued up and sized the hole.

As luck would have it, I had a few scrap steel spindles which somebody had given to me, many moons ago. These were of three different diameters; a short length of $\frac{3}{4}$ in. at the largest end, about $1\frac{1}{2}$ in. of $\frac{1}{2}$ in. diameter in the middle, and a short $\frac{3}{8}$ in. tail. One of these fitted the reamed hole exactly, without any shake, so I used that for the spindle of the "dividing head." The larger end was turned down to $\frac{3}{16}$ in. diameter for $\frac{1}{4}$ in. length, and screwed $\frac{3}{16}$ in. $\times$ 40, a nut being made to suit. A collar was made from a $\frac{1}{4}$-in. slice of $\frac{3}{4}$-in. brass rod, which I found among the short ends (I keep all my short ends of brass and gunmetal rod in the bench drawer under the lathe) so it only needed a $\frac{1}{2}$-in. hole drilled through it, and a $\frac{1}{8}$-in. set-screw in the side. The tail end of the spindle was centred, drilled 1 in. deep with a No. 21 drill, and a



Improvised dividing head



The job under way

4-B.A. set-screw fitted to it. Hey-presto—the Curly "patent" dividing-head was complete; and the time taken, about an hour. The chime clock was then dismantled as before, and the thin wheel taken out; I got it all to pieces much quicker than before ! The four teeth that I had filed up by hand, were all in good order.

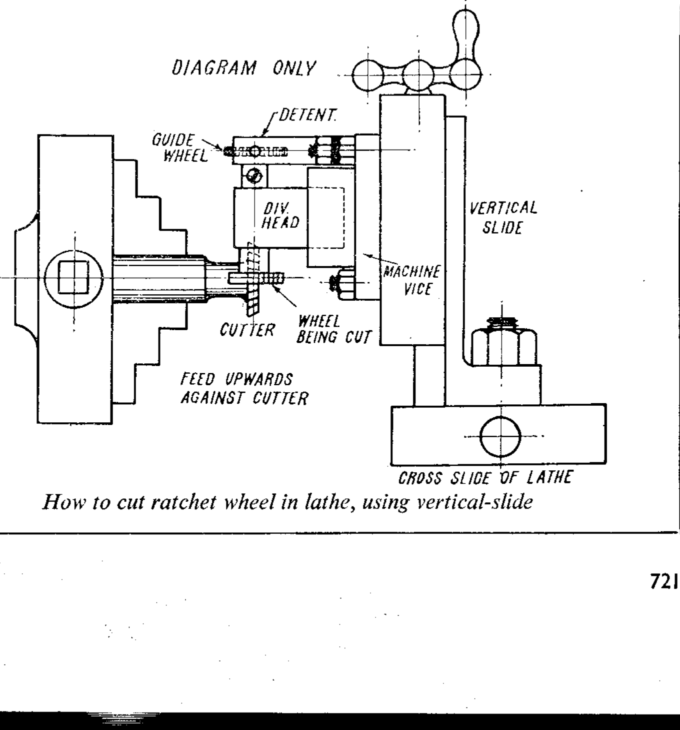
More Fakements

The next item required, was a cutter for the wheel teeth. Many years ago, a friend now on the other side of Jordan, gave me some small used milling cutters varying from 1 in. to 1½ in. diameter, and of varying thicknesses. Among these, I found one just the width of the wheel teeth. It was only made of cast steel, and was not too hard (if small milling cutters are too hard, the teeth break off) and I found that a file would just "bite" it ; so I reckoned that I could turn it to the profile of the tooth gap, without softening it, by aid of a Wimet tool. The little cutter had a ¼-in. hole through it; and as my vertical milling machine has a ½-in. collet among its accessories, I was able to use another of the scrap spindles mentioned above, as a cutter arbor. The end was turned down for ¼ in. length to ¼ in. diameter, screwed ¼ in. × 40, a nut made to suit, and the cutter mounted on it. The ½-in. part of the spindle was then chucked in the three-jaw on my Boley lathe, and I found that my surmise was correct, as a Wimet tool with a small round nose, had no difficulty in cutting the cast steel. It was only a few minutes' work to turn the toothed edge of the cutter, to the shape of the gap between the teeth of the old gear wheel, using same for a gauge. The cutter was left on the spindle, the ½-in. collet put in the milling-machine, and the ½ in. part of the spindle gripped in the collet.

Now we needed a blank from which to cut the wheel. I had a few brass blanks of varying diameters and thicknesses in stock, left over from the days when I did a bit of shopping up in town; so I picked out one 1¼ in. diameter and ⅛ in. thick, chucked it in the three-jaw, centred it, and poked a 3/16-in. drill through. After taking a skim off each side to true it up, I mounted it on the screwed pip on the spindle of my "dividing-head." This was then chucked in the three-jaw by the ½-in. section, and the blank turned down to the same diameter as the old thin gear wheel, which was 1 1/16 in. The spindle was then replaced in the "dividing-head," the collar put on, and adjusted so that there was no endplay, and the spindle could just be turned by hand. The 5/32-in. spindle on which the old thin gear-wheel was mounted, was then poked down the drilled hole in the tail of the spindle, and secured by the set-screw. The whole bag of tricks was then gripped in the machine-vice on the table of the vertical miller, the spindle being set dead level by aid of a scribing-block needle applied to each end. The height of the table was then adjusted to bring the centre of the spindle level with the centre of the cutter.

Not the Way Baby Cuts Teeth !

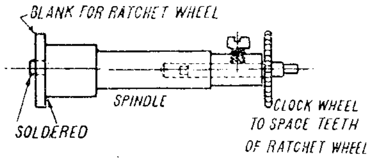
All we now needed was a detent to jam tightly in the spaces between the teeth of the old wheel, to hold it firmly while the cutter formed the new teeth in the blank; and that job was soon settled. A strip of 16-gauge steel, ½ in. wide, was bent at right-angles at 1 in. from the end, and a 5/16-in. hole drilled through it, to fit over one of the screws holding the vice to the table of the machine. A ⅛-in. hole was drilled in the strip, at the exact height of the spindle; a ½ in. length of 3/16 in. round mild-steel was turned for ⅛ in. to fit the hole, and riveted in; the end of it was filed to a wedge-shape, to fit between the teeth of the old wheel. When this gadget was placed over the end of the screw holding the machine-vice, and secured by an extra nut, the wedge jammed tightly between the teeth of the old gear-wheel; but the springiness of the strip was sufficient to allow the wedge to be disengaged by finger pressure from the gap between the



How to cut ratchet wheel in lathe, using vertical-slide

wheel teeth, whilst the wheel was turned around far enough to bring the next one into position.

We were now ready to cut, so the machine was started, and the slide adjusted so that the cutter took a bite out of the edge of the blank, to the exact depth of the gap between the teeth of the old wheel; this was



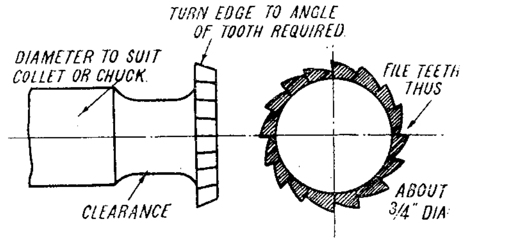
Blank and guide wheel mounted for cutting

merely a matter of careful measurement. The rest of the job was just a piece of cake. All I had to do, was to press the detent back, turn the spindle far enough to let it enter the next gap, and traverse the blank past the cutter. I took one precaution, though ! As the four teeth which I had hand-filed on the old wheel, approached the detent, I stopped the machine, leaving the cutter in the gap which it had just formed in the blank. The screw holding the spindle of the old wheel was then slackened, the detent held clear, and the old wheel turned around until my four bits of brass dentistry had passed it. The detent was then engaged with the original teeth again, the set-screw tightened, and cutting resumed as before. When the last cut had been made, the ex-blank, now a pretty gear wheel, was taken off the spindle, and rubbed both sides on a sheet of fine emerycloth, to remove the burrs left by the cutter, at each side of the teeth. On trying it against the original wheel, and the pinion to which it was going to transmit power, I found that it meshed perfectly; so all that remained, was to knock the old wheel off the pinion on the shaft, turn the step on the pinion to a full $\frac{1}{8}$ in. depth to accommodate the new wheel, press it on, and reassemble the clock. When this was done, the clock resumed business so eagerly, that it began to run ahead of the sun; so I had to let the pendulum down a little bit, to curb its exuberance ! I guess my new wheel runs easier than the old one, being over three times the thickness; the pressure on the teeth must be lighter in proportion to the area in contact with the pinion. I might add that I didn't have any trouble with the chiming and striking gears this time; Curly seldom forgets a lesson learned by experience, the finest teacher on earth. Anyway, though nothing to do with locomotive building, I found the job interesting, as it is the first clock wheel I have ever cut in my life, and will probable be the last—and my mind is easy now !

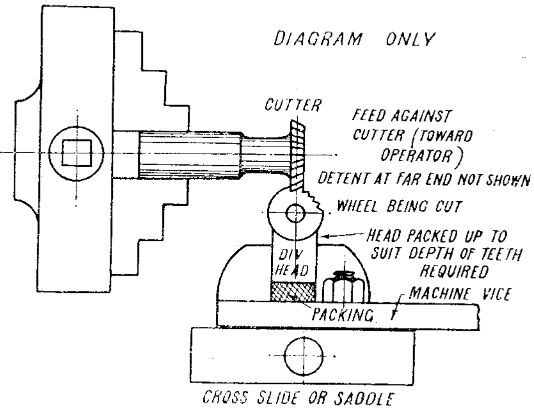
Same Process Cuts Ratchet Wheels

Any locomotive builder who owns a milling machine, horizontal or vertical, can use exactly the same rig-up for cutting true ratchet-wheels for mechanical lubricators; the teeth will be evenly spaced, and of uniform depth. The same simple " dividing-head " can be used, plus a cutter with angular teeth, and an old clock or other small gear-wheel, to use as " division-plate " for spacing the teeth. Among my small assortment of old clock wheels, taken from cheap broken alarms and other sources, I find that there are wheels with 30, 35, and 40 teeth, any of which would do fine for the purpose. The diameter doesn't matter, within reason; a wheel out of a toy Meccano set, or anything similar would answer just as well, as long as it has the required number of teeth. As to a cutter, ratchet-wheel cutters can be obtained from any firm supplying clockmakers' requisites (some of these good folk advertise in our " smalls " columns) but a cutter can easily be made by anybody with the average amount of gumption. The easiest way is to make it all in one piece with the spindle, like the commercial cutters sold for cutting seats for Woodruff keys. Chuck a short length of round cast steel, or silver-steel, about $\frac{3}{4}$ in. diameter, in the three-jaw. Face the end, and turn about $\frac{1}{2}$ in. length to $\frac{1}{2}$ in. diameter, starting a little over $\frac{1}{16}$ in. from the end, leaving a disc of full diameter, to form the cutter. With a left-hand knife tool, or a parting-tool, cut back the spindle side, so as to leave about $\frac{3}{16}$ in. of the cutter-blank parallel; then bevel off the edge, to the angle required for the teeth. With a small three-square file, cut teeth all around the edge, like a milling-cutter, or a glorified ratchet-wheel; it doesn't matter a bean about their being even, or even all the same depth. Some cutters, also reamers, have the teeth cut unevenly on purpose, to prevent chattering. Harden and temper the cutter to dark yellow, by the same process that I have described many times for D-bits, pin-drills and the like.

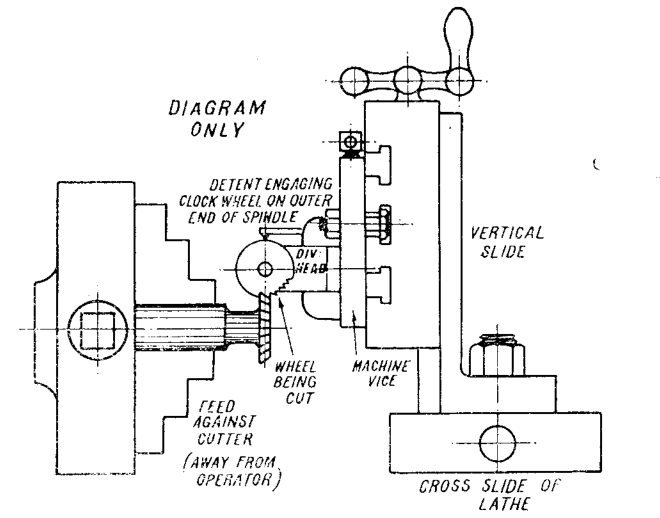
The set-up for cutting the ratchet wheel, is exactly as described above. The " dividing-head " is held in a machine-vice on the table of the miller. If a vertical mill is used, set the spindle level with the centre of the cutter, same being held either in a collet, or in a chuck on the spindle. The blank for the ratchet wheel can be a 3/32-in. slice parted off a piece of $\frac{7}{16}$-in. cast or mild-steel bar, which will be O.K. for my



Home-made ratchet wheel cutter



How to cut ratchet wheels without a vertical-slide. (Same set-up does for horizontal miller)



Alternative way of using vertical-slide

"standard" lubricators; the blank can, of course, be larger or smaller, according to requirements. As the hole in the middle is only 3/32 in. on the standard size, and a stud of that size on the end of the spindle isn't very strong to withstand the stress of cutting the teeth, a 3/32-in. pip could be turned on the end of the spindle, the ratchet-wheel blank pushed on to it, and temporarily soldered, as shown in the diagram. The solder would hold the wheel blank quite firmly while the dental job is in progress, and the wheel is easily melted off afterwards. If the wheel is made from cast or silver-steel, harden and temper it to dark yellow. If of mild-steel, case-harden it by the method described for the pawls.

If a horizontal milling-machine is used, there is no difference in the apparatus needed; it is merely a matter of setting the wheel-blank under the cutter, instead of alongside it, as shown in the diagram. In either case, once the first tooth, or rather gap between teeth, is cut (I wonder if the folk who talk about "negative lead" would call it a "negative tooth" !) to the required depth, all you have to do, is to move the table or slide back, press the detent clear of the guide wheel teeth, move the wheel to the next space, release the detent so that it engages, and move the table or slide forward again. Each tooth is thus formed with a single cut; and if the spacing on the guide wheel is even, the spacing of the ratchet teeth must be even also. When the ratchet wheel is fitted to the lubricator, and the pawl set to click one tooth per waggle of the lever, it will ditto repeato through the whole complete revolution of the wheel, without either missing or "twicing," and the oil feed will be perfectly regular, as it *should* be.

Doing the Job in the Lathe

If no milling-machine is available, the job can be done practically as easily, in the lathe. If you have a vertical-slide—every lathe should be furnished with one, as standard equipment—it is as easy as eating pie. Bolt a small machine-vice to the slide, and grip the "Curly patent dividing-head" in it. Incidentally, for these small ratchet wheels, you don't need one nearly so big as I used for the clock wheel; one with ¼ in. spindle would do, and a bit of bar as used for axle-boxes, would be plenty big enough for the bearing. Hold the spindle carrying the cutter, in the three-jaw, and set the vertical-slide as shown in the diagram. The teeth are cut by moving the vertical slide up and down, shifting the detent one space at a time, as before.

The *modus operandi* for a lathe with no vertical-slide, is the same as for the horizontal milling-machine; but as there is no adjustment for raising or lowering, the cut would have to be set for depth, by adjusting the body or bearing of the "dividing-head" up or down in the machine vice, until the correct depth of cut is obtained. After that, it is all plain sailing, as the rest of the teeth will naturally be cut to the same depth as the first one, merely by turning the spindle one space at a time, as before, and feeding the blank under the cutter by moving the cross-slide.

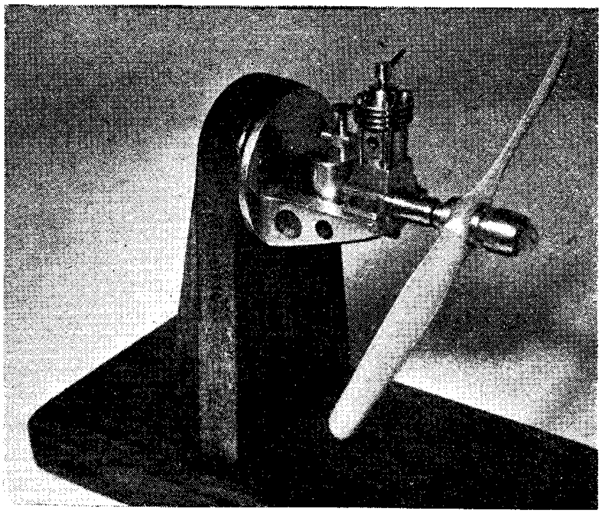
Materials

The above simple methods of ratchet-wheel cutting, should solve the problem of anybody whose lubricator feeds erratically, or misses altogether. By the way, although I mentioned above that the blanks for the ratchet-wheels should be cast or mild steel, there is no objection to the use of hard bronze. Two of my locomotives, *Ayesha* and *Grosvenor* (first and latest) have hard bronze ratchet wheels, and they work O.K. and show no appreciable signs of wear. *Ayesha* hasn't had hers all through her long life, as she ran for many years with her original displacement lubricator. After I experimented with mechanical lubricators, and got out a satisfactory type, I fitted them to all my own engines—I just love taking my own medicine !—and so the old girl got hers in turn. The wheels have 40-teeth apiece, and the pawls needed fitting accurately; but they have never given any trouble through missing on the road. However, if bronze is used, it should be of the hard-drawn variety, not cast stick; the latter is rather too brittle. Soft brass should on no account be used, as the teeth will go to glory after very little use. I had plenty of experience of the shortcomings of brass ratchet wheels, in the far-off days when I did a bit of gramophone repairing.

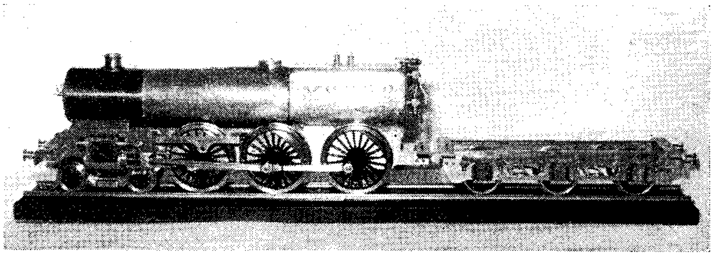
Although the rig-up described above, is only a ragtime job, and will probably earn the disapproval of those good folk who like things "just so," as my old granny would have said, I might point out that the simple "dividing-head" is capable of elaboration. The spindle could be drilled right through, for example, the end countersunk to the same taper as used for commercial collets, and a drawbolt fitted, giving precision centring at one fell swoop. The end could also be screwed like a miniature lathe mandrel nose, and a small commercial chuck, or home-made chucks of any sort, fitted to it. There is also a simple way of making a regular division-plate by aid of clock wheels as spacers for the holes; I will have to tell you about that some other time, circumstances and the K.B.P. permitting.

MODELS AT THE

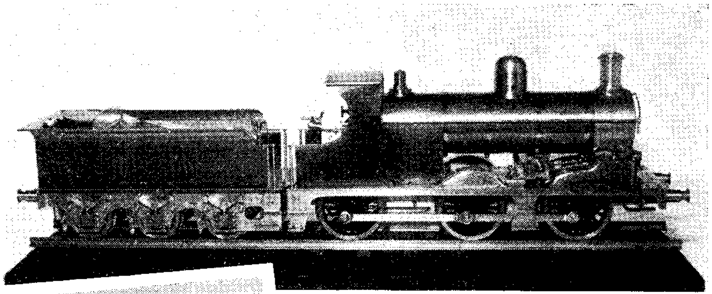
Wakefield Exhibition



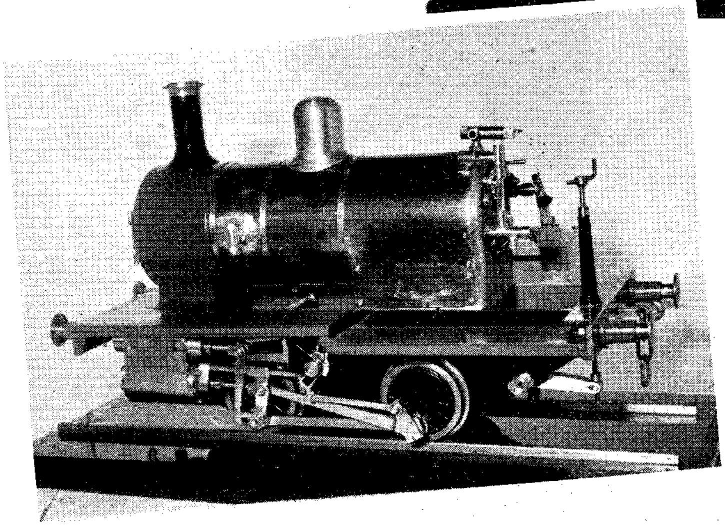
Left: One of a pair of "matching" compression-ignition engines, built by S. C. Smith of Sheffield. These were machined from the solid, had plastic air-screws, and were neatly mounted.



Right: Mr. Freeman's second loco., not yet finished, is this ½-in. scale L.M.S. 5XP. Once again the finish was very good.

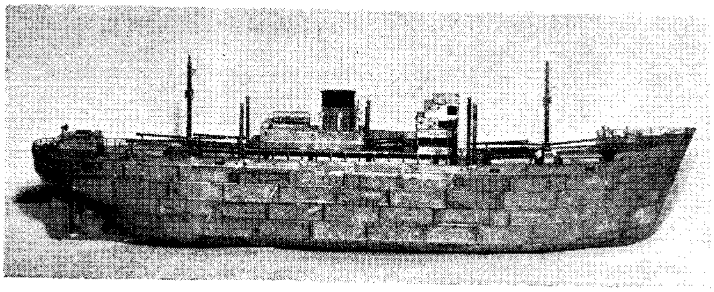


Right: An extremely good "first attempt" by loco-driver J. S. Freeman, of Normanton, this ½-inch. scale "Aspinall," showed excellent craftsmanship in all respects.



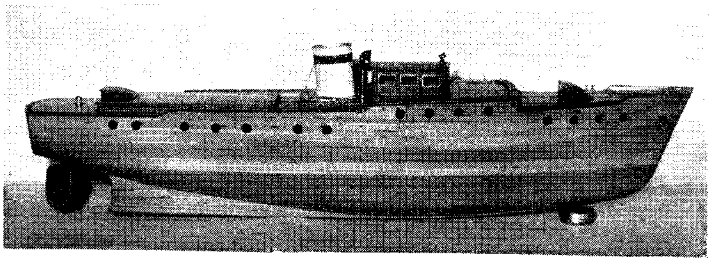
Left: Since "L.B.S.C." first published the design, "Tich" has proved rightly popular. This very nice example, built by J. Jackson of Ossett, was well-finished in both machine and hand-work.

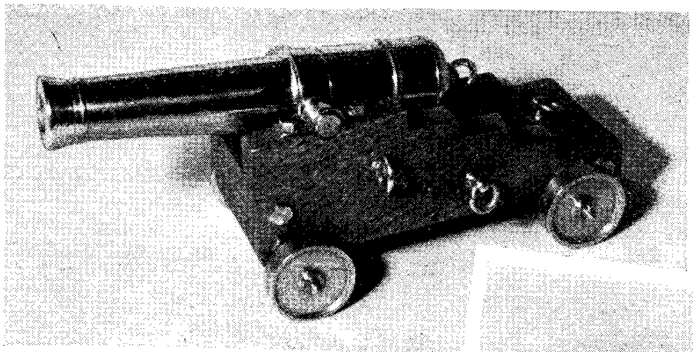
Photographed by "Northerner"



Left: P. Crossley of Barnsley is building this cargo-passenger liner in tinplate, and intends fitting a steam-engine. The dummy riveting on the plates could have been straighter by the use of a simple jig.

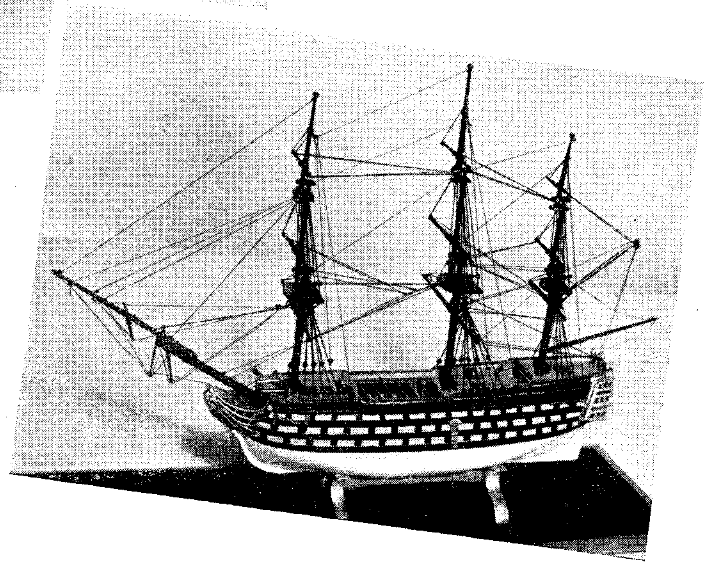
Right: The shapely and well-finished hull of this river-launch was built bread-and-butter fashion by R. H. Wagstaffe of Leeds: it appeared, however, to be of a rather unnecessarily deep draught for this class of vessel.





Left: Another ornamental model, this time built for that purpose by L. R. Raper, and quite a departure from his usual locos. The metal parts are polished brass, mounted on an oak carriage.

Right: An excellent little decorative model of H.M.S. "Victory," by C. Littlejohn of Wakefield: the rigging, all in black thread, was the only jarring feature.



READERS' LETTERS

● **Letters of general interest on all subjects relating to model engineering are welcomed. A nom-de-plume may be used if desired, but the name and address of the sender must accompany the letter The Managing Editor does not accept responsibility for the views expressed by correspondents.**

WHY?

DEAR SIR,—I am making the 5-in. gauge edition of *Titfield Thunderbolt* to "L.B.S.C.'s" words and music. In the past I have worked mainly on 7-mm. scale models, and in the small scales, very great attention is paid to appearance of the finished job. Why is this not so in $3\frac{1}{2}$-in. and 5-in. gauges? It is much easier to work to scale, or nearly so, than in the small scales. The point that has roused me to write to you, is the matter of wheels. The castings I received for the wheels of the "Lion" engine, should be finished at $5\frac{5}{16}$ in. diameter. If they are finished this size, they look too silly for words. The "Lion" had light slender sort of wheels, with narrow rims and tyres. These castings, even finished at 5 in. diameter, are still too heavy in the rim. The photograph of an "Invicta" in THE MODEL ENGINEER for November 5th, shows just how bad these heavy rims do look.

As this is one place where the out-of-scale proportions are of no functional advantage of any kind, why is it done?

The standards of appearance in the small scales are very high indeed nowadays. Cannot we start a move for a corresponding improvement in the large scales? It ought to be simple enough.

Yours faithfully,

Cheam. M. H. COX.

SURFACE TREATMENT OF METALS

DEAR SIR,—Congratulations to Mr. C. G. Green on his excellent article in THE MODEL ENGINEER for November 5th. Articles of this sort are of great value to people like myself who build somewhat complicated models and then find difficulty in getting paint to adhere properly to oily and sometimes rusty surfaces. I, for one, would like to see the theme continued further to deal with methods of treating brass, etc., to receive paint.

I have in mind the painting of the axleboxes for my "Dean" bogie single which were fabricated mainly by silver-soldering and partly by soft-soldering.

As I see it, these cannot be satisfactorily acid dipped to etch the surfaces away to the soft solder, and the need to protect the bearing surfaces, etc.,

I know that both Mr. G. S. Willoughby and Mr. Austin-Walton have written articles on some methods of preparing metal surfaces, but the possibilities suggested by Mr. Green seem even more interesting.

Yours truly,

Maidenhead. D. G. WEBSTER.

DE-RUSTING IRON AND STEEL

DEAR SIR,—In his article in THE MODEL ENGINEER dated November 5th, 1953, Mr. C. G. Green gives a somewhat complicated method for the de-rusting, and the subsequent protection, of ferrous metals. This involves the use of a bath of hydrochloric acid (which Mr. Green seems to suggest is available in any model engineer's workshop), a thorough rinse in hot running water, and, after drying, either a dip in a hot phosphating bath or a painting on of a phosphating solution.

However, there is a very much easier method than that, in the use of "Jenolite" solution, either in the form of a bath (no heat required), or painted on. For small articles, I use the former method, an old enamelled pie-dish being the receptacle; for, say, rust-spots on the car or lathe, the liquid is painted on. A light film of rust will be removed almost instanteneously, and I have de-rusted a heavily-corroded length of steam-barrel—outside *and* inside, of course, using the bath—in about ten minutes' immersion.

As for the phosphating for after-protection of the surface, "Jenolite" does this in the single operation. When the rust has disappeared, simply leave the article to dry, without rinsing, and the phosphated surface is there, ready for painting. As Mr. Green states, the phosphate acts as a key to the paint, as well as a rust-preventive, and so is doubly efficacious.

And by the way, if the local water leaves a brownish stain on your enamelled bath, "Jenolite" will soon remove it; a point which appeals to the domestic authorities. Another point in its favour is that it is readily obtainable, at most good hardware stores, paintshops, or garages, and also at branches of Halfords.

In conclusion, I have no connection with the "Jenolite" people, except as a very satisfied user of this excellent product.

Yours faithfully,

Sheffield. "NORTHERNER."

OLD TRACTION ENGINES

DEAR SIR,—Three miles along the road from Gloucester to Bristol just beyond Hardwick on the left-hand side is a yard where 17 traction engines are standing. I did not have much time to spare, but I was able to get some of the details. Unfortunately, I was not able to get all their numbers, as they were well sheeted over. The owner tells me he bought them all for preservation, and has sold one or two of them to other people for the same purpose. At the time of my visit he was busy retubing one of the Burrell single-crank compounds. The whole of the engines are in good working order though somewhat dirty.

The particulars are as follows:— Burrell Showman, No. 3912; Fowler 7 h.p.; Burrell No. 3786; Burrell single-crank compound; Fowler, No. 12693; Wallis & Steevens compound; Burrell single-crank compound (being retubed); Burrell, No. 3739; Burrell; Burrell, No. 3031; Foster; Aveling & Porter; Aveling & Porter roller; Wallis & Steevens; Allchin, No. 1311; Foden, No. 9052; Burrell, No. 3809.

There are five other engines in a rather derilict condition which I did not have time to look at.

Yours faithfully,

Birmingham. C. M. UREN.

P.S. "VICTORIA"

DEAR SIR,—I was sorry to see in a recent issue of THE MODEL ENGINEER that the *Victoria* has been broken up. I knew her very well, and used to take my sons, when they were small, to see a real oscillating engine. I feared the end could not be far off. "Student" has done a difficult job well in getting those photographs, but I suppose the superstructure had already been removed when he took them.

Yours faithfully,

Swanage. H. E. RENDALL

Centring Faceplate Work

By "Duplex"

WORK too large to be mounted and centred in the four-jaw chuck can often be readily held for machining on the lathe faceplate by means of the ordinary faceplate clamps, fitted with a bolt and a jack-screw. The following notes are, however, intended for those who have had but little experience of setting up work in this way.

The part illustrated in Fig. 1 may be taken as a typical example and, here, the off-centre boss has to be faced and then turned to a given diameter to form a register for mounting a second component. Where the edges of the base have been filed or machined square, the part can quite well be located on the faceplate with the aid of a rule by making use of the measurements set out in Fig. 2. The faceplate is placed on the bench with the bolting surface uppermost, and, after the edges of the work have been set at the correct distance from the rim of the faceplate, the holding clamps are tightened. The assembly can now be mounted on the lathe mandrel and the boss machined to size.

If the boss is to be drilled for the passage of a central bolt, forming part of the construction, the drilling centre can be first marked-out and then centre-drilled to serve as a guide for centring the work on the faceplate. For this purpose, the casting is supported by an angle-plate resting on the surface-plate, as shown in Fig. 3, and the two centre-lines of the bolt hole are, in turn, scribed with the surface-gauge, set to correspond to the dimensions given in the drawing. Some angle-plates are not fully machined, but the "Eclipse" pattern have their end faces machined to enable the angle-plate to be stood on end for scribing the second cross centre-line.

With the faceplate again placed on the bench, the work is lightly clamped in place after being approximately centred with reference to the guide circles machined on the bolting surface of the plate.

When the faceplate has been mounted on the lathe mandrel, the drilled centre can readily be set to run truly by means of a centre-finder or wobbler, as it is sometimes called. This useful appliance and its practical application were described in a previous article, so need not be repeated. Briefly, as shown

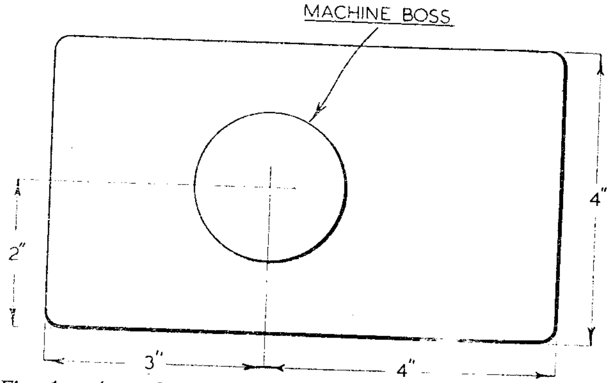
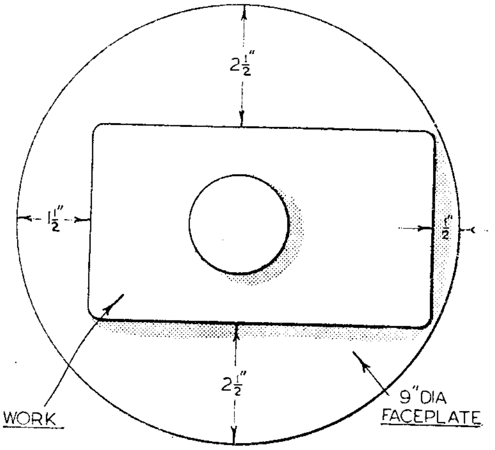


Fig. 1. A work-piece for mounting on the faceplate to machine the boss



Right: Fig. 2. Centring the boss by measurement with a rule

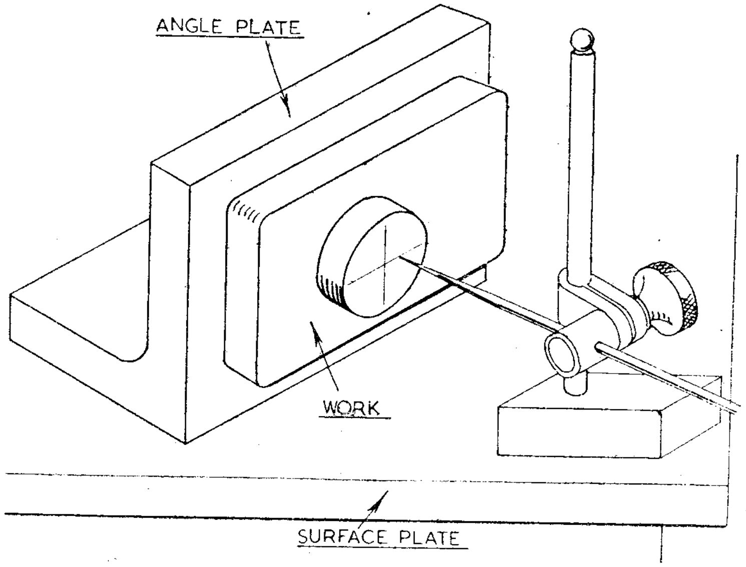


Fig. 3. Marking-out the boss centre

diagrammatically in Fig. 4, the coned point of the wobbler is engaged in the centre drilled in the work and the other end, fitted with a spring-loaded, female centre, is supported by the tailstock centre. If the test indicator is now mounted in the lathe toolpost, with the plunger in contact with the wobbler, and the lathe mandrel is turned slowly by hand, the indicator needle will register any departure from the correct setting of the work. Any error can now be corrected by lightly tapping the work with a raw-hide mallet, and the faceplate clamps are then finally tightened. As represented in Fig. 5, the tailstock centre itself can sometimes be engaged directly for centring the work, but as a rule the tailstock barrel is too short to allow of this, as it will not span the full width of the saddle.

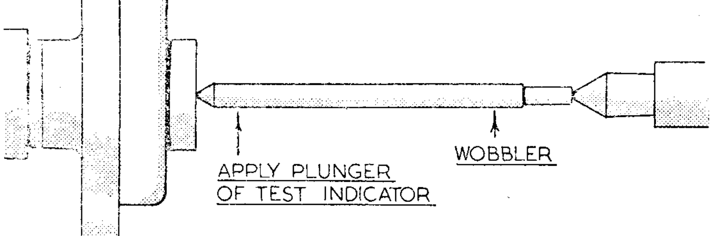
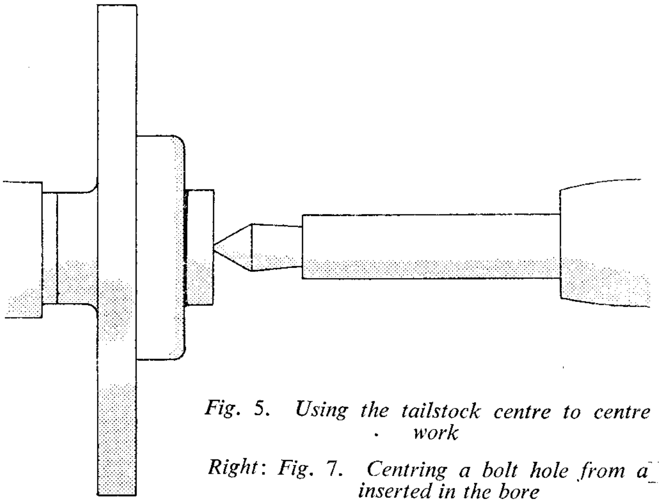


Fig. 4. Centring the work centre with the centre-finder

Sometimes, however, this difficulty can be overcome in the following way. After the work has been centre-drilled to locate a hole for, say, a ⅜ in. diameter bolt, this centre is drilled out to the full diameter. Next, as shown in Fig. 6, a short



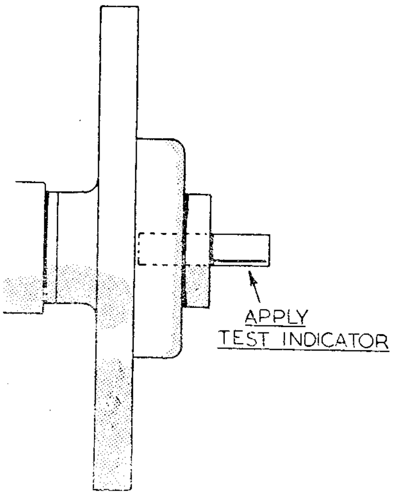
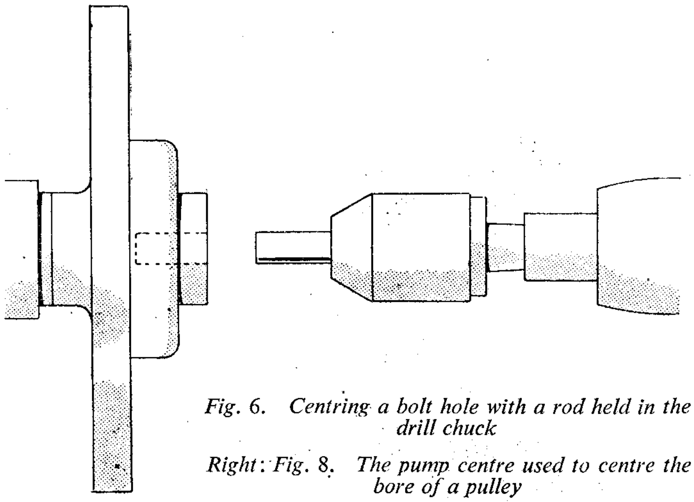


Fig. 5. Using the tailstock centre to centre the work

Right: Fig. 7. Centring a bolt hole from a rod inserted in the bore



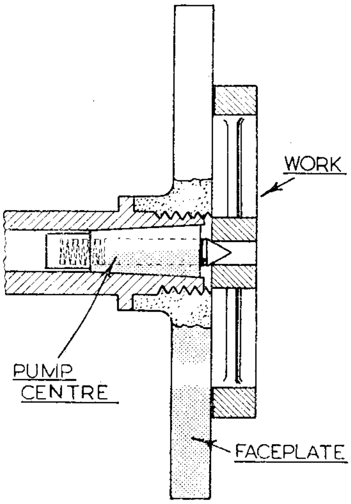


Fig. 6. Centring a bolt hole with a rod held in the drill chuck

Right: Fig. 8. The pump centre used to centre the bore of a pulley

length of ⅜ in. diameter rod is gripped in the tailstock drill-chuck, and this rod is entered in the work to centre the bolt hole before the faceplate clamps are tightened.

Another way of setting the bolt hole to run truly is illustrated in Fig. 7. Here, a short length of rod is fitted in the bolt hole, and the work is adjusted on the faceplate until the test indicator shows that the rod is running truly.

Another fitting, used chiefly in small precision lathes for centring clock and instrument parts, is the pump centre.

As shown in Fig. 8, this consists of a spring-loaded, parallel spindle with a coned tip, sliding in a body mounted in the lathe mandrel. To centre a part, such as a clock wheel or pulley, the centre is engaged in the bore and, as the wheel is pressed down by the faceplate clamps, the centre recedes and at the same time maintains the work in alignment. Needless to say, this fitting must be accurately made if it is to centre the work properly.

Where the bore of a work-piece has to be enlarged exactly centrally, the pump centre is first engaged and the faceplate, with the work securely clamped in place, is then unscrewed from the mandrel to allow the pump centre itself to be removed, in order to afford a clear passage for the boring tool.

The pump centre illustrated in Fig. 9 is designed for use in lathes having a Morse taper bore at the mandrel nose.

The body *A* is turned from a length of mild-steel rod and, after the bore has been drilled and machined with a small boring tool, the thread for mounting the thimble *B* is cut. Next, the outside is turned taper to fit the lathe mandrel. The bore should be finally lapped to remove the tool marks and to endure parallelism.

After the centre *C* has been turned 1-thou. in., or so, oversize and the coned point formed by setting over the lathe topslide, the part is lapped to a close sliding fit in the body.

The thimble *B* is knurled and then threaded externally to screw into the body. Following this, a recess is bored at either end to accommodate the spring as well as the head of the retaining screw *D*. The spring fitted should be strong enough to ensure that the work-piece is held centrally while the clamping-bolts are being tightened.

As shown in the drawing, the front face of the body has been drilled to take a peg-spanner for removing the fitting from the lathe mandrel, but for this purpose a bumper is commonly used, consisting of a length of brass rod, inserted in the mandrel bore and flicked forward to strike against the inner end of the tapered shank.

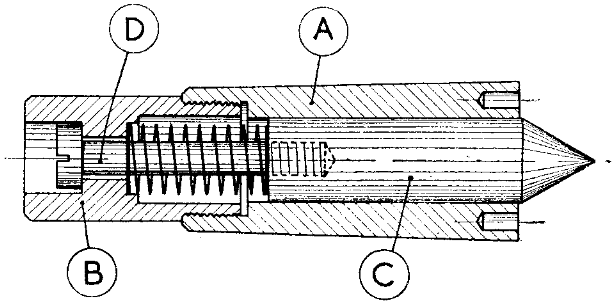


Fig. 9. The pump centre. A—the body; B—the thimble; C—the sliding centre; D—the retaining-screw

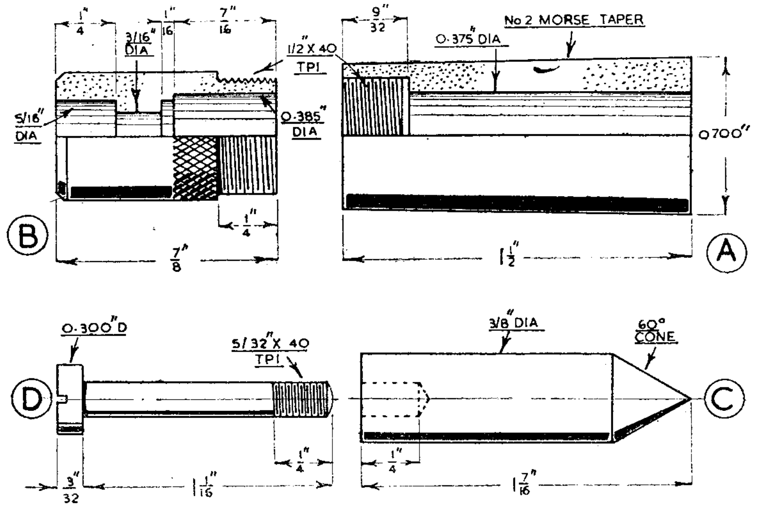


Fig. 10. Dimensions of the pump centre illustrated

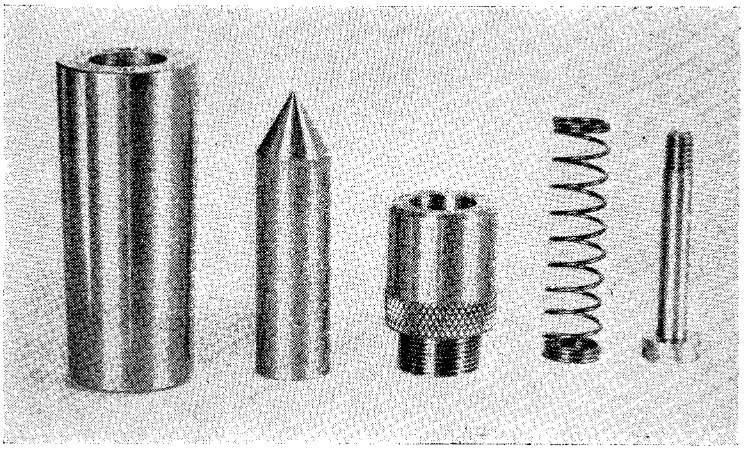


Fig. 11. The parts of the pump centre

A Finished "BRITANNIA"

By H.M.C.

HAVING completed a G.N. Pacific in 3½-in. gauge, my appetite was whetted for more. A visit to the South Bank Exhibition provided the answer. The truly magnificent spectacle of *William Shakespeare*, resplendent in shining green livery, polished motionwork and lovely copper pipes left no room for doubt—*Britannia* it must be !

Backed by the whole-hearted approval of my son, whose moral support I knew I should ultimately need, work was commenced on October 19th, 1951. Since I was to receive his support on the domestic front, it was agreed that I should present him with a weekly progress report, and he would make frequent reference to the project in his letters home—Mothers will suffer anything for their sons ! Consequently, a detailed record was kept of all processes and time spent upon them.

Britannia was built to " L.B.S.C.'s" design with minor modifications. An air test was made at 378 hours, a steam test at 759 hours, with a total building time of 998 hours spread over 23 months. I had quite a few instalments of the serial in hand, and, bearing in mind our worthy friend's hint in the preview of his *Britannia*, the boiler was made as described for *Pamela* with the necessary modifications in outline, and so I was able to run well ahead of schedule. The cylinders were fabricated, as were motion-brackets, guide-bar brackets, pony truck and front bogie. In fact, the only castings used were the wheels and regulator spindle cover on the smokebox, the latter being produced by the " lost wax " technique. A pair of cast nameplates were purchased from an " M.E." advertiser and, upon their receipt, promptly consigned to the scrapbox as being hopelessly overscale.

The piston stuffing-boxes were packed with graphited asbestos yarn but were made to give the appearance of metallic packing boxes. Valve-guides were fitted to give a touch of realism. Cast-iron piston-valves were fitted in the gunmetal liners on an adjustable sleeve, to enable them to be adjusted from the front end of the liner.

The regulator is of the poppet-valve type fitted in the smokebox, as described and condemned in the same instalment by our good friend " L.B.S.C."

The boiler barrel, wrapper plate and backhead were cleaded, and all backhead fittings, with the exception of the water-gauge, were fixed on the cleading. A three-hopper ash-pan was fitted and so arranged that a new grate can be inserted without removing the boiler from the frames.

A three-note chime whistle was fitted in the approved manner beneath the footplate. Cylinder drains operate from the cab. All springs are of the working leaf type, made from old Eclipse Junior hacksaw blades.

An " L.B.S.C."-type injector was fitted. Teething troubles were experienced, but it is now an excellent performer and can be started whilst the locomotive is running.

Steam for the ring blower is conveyed through an external pipe. An expansion loop feeding the steam to the cylinders was fitted to simplify connections inside the smokebox.

The profiles of some of the motion-work components were modified to conform to the prototype, and castle-nuts and split-pins were fitted to the crosshead pin and coupling-rod joint-pin. Slippers were faced with white-metal.

The mechanical lubricator was the standard " L.B.S.C." job, with a 30-tooth ratchet wheel to give a " full and plenty " supply of cylinder oil and ensure adequate lubrication to the piston-valves. In fact, like the prototype, after an hour's steaming the boiler is liberally and realistically splattered with cylinder oil !

Britannia has now completed 70 hours' steaming, after making her bow at the Birmingham Rally with a borrowed tender. Initially, teething troubles were experienced. After a quarter-of-a-mile running on a continuous track, the boiler pressure dropped to 50 p.s.i. A bad blow from the chimney was in evidence. Upon investigation it was found to be due to distortion of the P.V. liners when they were pressed in,

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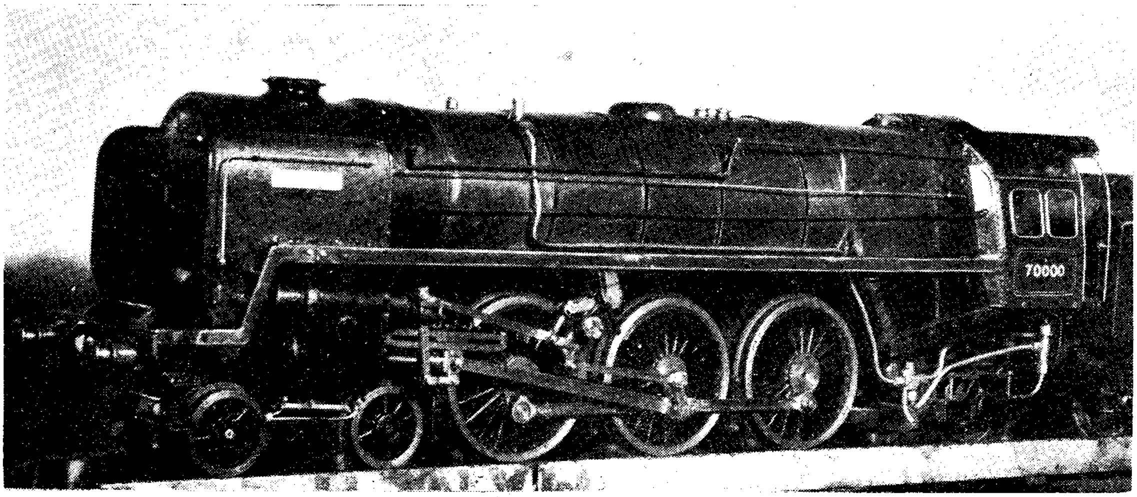


QUERIES AND REPLIES

"THE M.E." FREE ADVICE SERVICE. Queries from readers on matters connected with model engineering are replied to by post as promptly as possible. If considered of general interest the query and reply may also be published on this page. The following rules must, however, be complied with:

(1) Queries must be of a practical nature on subjects within the scope of this journal.
(2) Only queries which admit of a reasonably brief reply can be dealt with.
(3) Queries should not be sent under the same cover as any other communication.
(4) Queries involving the buying, selling, or valuation of models or equipment, or hypothetical queries such as examination questions, cannot be answered.
(5) A stamped addressed envelope must accompany each query.
(6) Envelopes must be marked "Query" and be addressed to THE MODEL ENGINEER, 19-20, Noel Street, London, W.1.

G.N.R. Locomotive Colours

I have a model of a Great Northern Railway Stirling 8-ft. single-wheeler to repaint for a friend, and would be obliged if you could let me have particulars of the colours to be used. I assume that the original G.N.R. colours were not the same as the L.N.E.R. engines were painted.

F.S.B. (London S.W.9).

The old Great Northern Railway colours were quite different from those of the L.N.E.R. The main colour was a rich bright green best described, perhaps, as "emerald" green. This was used for boiler, cab, tender body and the wheels. The boiler bands were black with a white line on each edge. The splashers of the bogie and the driving wheels were green; they were outlined with flat, polished brass beading, below the inner edge of which there was a thin black stripe bordered by a white line next to the green. The front and back edges of the cab were stiffened with half-round beading painted black, and next to the inner edges was a white line. The sides and back of the tender were, of course, painted the same bright green as for the engine, but were given a deep bordering of dark olive green; the corners of the panels, so formed, were rounded inwards, and on the inner edge all round the border was a black stripe, $1\frac{1}{2}$ in. wide, having a white line on each side of it.

Outside frames, footplate edging, footsteps and that part of the main frames of the engine projecting above foot-plate level at the front were dark red-brown, outlined in vermilion. The main frames of the engine below footplate level, were black; the guard-irons also were black. The axle-ends of the wheels were black, surrounded by a white line; the bosses were outlined in black, edged on the inside with a white line.

Buffer-beams were Post Office red bordered with a narrow black stripe and white line. The engine's number, with the abbreviation "No.," was carried on the front beam in plain gold-leaf letters and numerals, back-shaded in blue picked out in white. The number on the cab side and the initials "G.N.R." on the tender were also in gold-leaf but back-shaded in red merging to black and picked out in white. The tyres were black with a white line all round the inner edge of each. Safety-valve casing and whistle were polished brass, while buffer heads, couplings, hand-rails and smokebox-door hinges were polished steel. The buffer sockets were red-brown.

Washing Out a Boiler

I have almost completed a $1\frac{1}{2}$-in. scale traction engine, the boiler of which is of copper and has twelve $\frac{7}{16}$-in. tubes and one superheater. When I steamed it for the first time, it primed badly and the water surged up and down the water-gauge, suggesting that there was some oil and possibly some soldering flux still inside. Can you tell me what chemical I can safely use to remove them?

R.C. (St. Columb).

We suggest that a strong solution of caustic soda would remove most of the impurities that have been left in the boiler. Alternatively, a very strong solution of ordinary household soda would be almost as effective and probably cheaper. In neither case, is there any risk of corrosion being set up, provided that, after treatment, the boiler is thoroughly washed out with warm water so as to remove all traces of the soda.

Model Locomotive Query

I intend to take up model engineering on the locomotive and i.c. engine side. Can you say what would be a suitable locomotive for a beginner to tackle? What is the approximate cost of constructing a locomotive?

D.W.J.B. (Blackpool).

We are unable to give you a precise answer to either of your questions. Our plans list contains particulars of several different miniature steam locomotives, nearly all of which are intended primarily for beginners and have been described in back issues of THE MODEL ENGINEER. We would suggest that you might consider *Tich* or *Juliet*, each of which can be built with very modest workshop facilities and gives a good, working engine when finished.

A FINISHED "BRITANNIA"

(*Continued from previous page*)

although they were reamed *in situ* after fitting. A lap was made, liners lapped and new piston valves fitted, with gratifying results. Further improvement was necessary and the blast nozzle was lowered in the smokebox with the desired results.

The axle-driven pump ceased to function, and, upon investigation, it was found that the suction-valve was stuck up off its seat with a trace of graphite and grease which had obviously worked through from the gland packing.

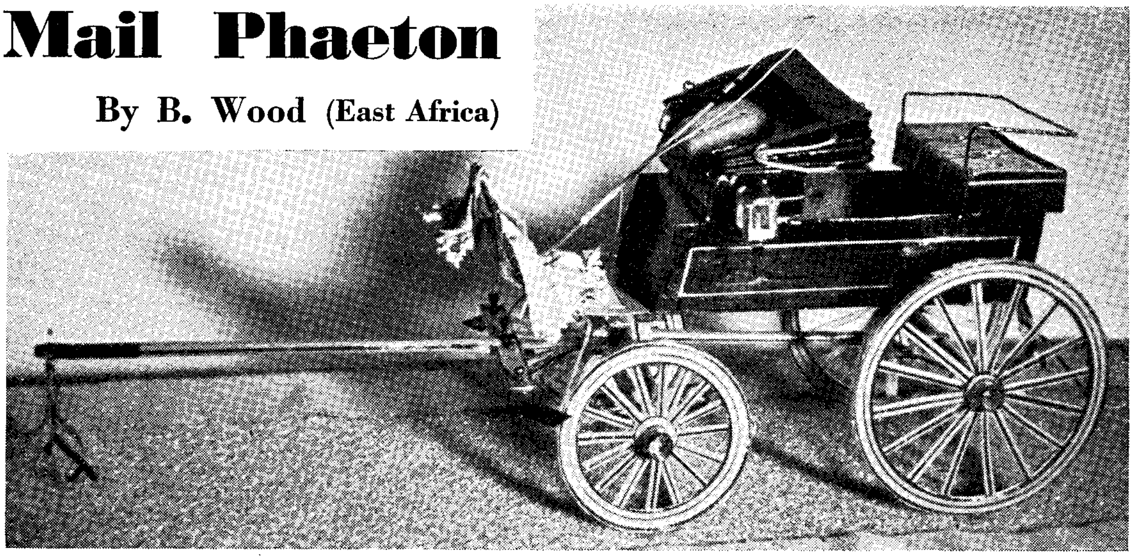
To simplify connecting up, the number of connections between engine and tender is reduced to two, and these are simply ordinary male and female metal tapered joints as used on medical equipment. They are fitted on the suggestion of Dr. P. S. Dearden of the Warrington club. One connects the tender pump delivery, and one a common suction line for axle pump and injector, and nothing more is needed.

The injector water supply was taken from a tee-piece in the axle pump suction line, which is $\frac{1}{4}$-in. bore and of ample capacity for both pump and injector, to the injector water cock. The by-pass was connected to the suction line also, so that, when starting, the opening of the by-pass has the effect of allowing the water from the tender to flood up the axle pump delivery pipe and prime the pump. This system has proved its worth on my G.N. Pacific, which has now been working frequently and successfully for five years.

For the photograph I am indebted to Dr. H. E. Vickers, a fellow-sufferer from the same incurable disease. Speaking as a medical man, he says there is no cure. The only treatment which will give any relief to the victim is "engines, and more engines!"

A model
Mail Phaeton

By B. Wood (East Africa)



AT the recent Arts and Crafts Exhibition held in Nairobi, a really outstanding exhibit was the work of Lt.-Col. Barcroft.

This perfectly scaled model, created a great deal of interest and comment. The photographs, taken by Mr. J. S. Karmali, will give the reader some idea of the wealth of detail incorporated in this model.

The lamps, less than half-an-inch in length and quarter-of-an-inch square, are fitted with reflectors and windows, the finish being in black and gold. Finish on the pole and splinter bar is red, lined in black, while the pole-pieces are the correct leather brown, with silver buckles.

Fitted to the splash board is the whip bucket, which in the photographs is not shown holding the whip itself. The reason is that as the phaeton is obviously new, and has just been delivered, the stableman would remove the whip from the bucket to discount any chance of its being broken.

The whip itself is a work of art, the strap, collars and binding clearly discernible and perfectly finished.

Blue upholstery, with black buttons and brown leather upholstery ties, complete with buckles, finish the box and rumble seats.

The hood can be made to operate on the hood brackets.

The roller bolts and elliptical springs (the latter work perfectly) are clearly shown.

Finish of the paintwork and coach as a whole is excellent, and obviously the author of this fine piece has an intimate knowledge of his subject, and the skill and ingenuity to develop and apply the specialised techniques necessary to create in minature, a duplicate of the prototype, out of ordinary, every-day materials.

The model fills its purpose admirably, in that it has given, and will continue to give, a great deal of pleasure to those fortunate enough to examine and admire it.